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GEORGE OTIS SMITH, DIRECTOR

THE FAIRBANKS AND RAMPART QUADRANGLES

YUKON-TANANA REGION, ALASKA

BY

L. M. PRINDLE

WITH A SECTION ON THE RAMPART PLACERS

BY

F. L. HESS

AND A PAPER ON THE WATER SUPPLY OF THE FAIRBANKS REGION

BY

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CONTENTS.

ILLUSTRATIONS.

PREFACE.

By Alfred H. Brooks.

In planning the surveys and investigations of Alaska, the attempt was made to cover first those regions which were of the greatest economic importance. As a result of this, many of the mapped areas are very irregular in outline, and it now seems desirable to introduce greater uniformity into the published maps as rapidly as the data available for their preparation will permit. With this end in view a system of maps has been projected covering quadrangular areas outlined by parallels of latitude and meridians of longitude, this being in conformity with practice in surveys made within the United States proper. But as the Alaska surveys are for the most part of a reconnaissance character and the region is very thinly populated, it has seemed best to adopt a map unit larger than that used in the States. This unit will include 4 degrees of longitude and 2 degrees of latitude, making a map about as large as can be conveniently handled. It is hoped that eventually these published reconnaissance topographic maps can be accompanied by sheets showing the geology and the economic resources, but in view of the great demand for the topographic maps it has been deemed advisable to publish them immediately with such accounts of the geology and mineral resources as may be available. Nor is it deemed desirable to delay the issuing of maps until the areas have been completely covered.

The following report, with its accompanying maps (Pls. I, IV, and V), is the second of this series to be issued, and it will be followed by others as fast as the accumulation of the field notes will permit. The topographic surveys on which the maps are based were made under the direction of T. G. Gerdine in 1903 and D. C. Witherspoon in 1904, 1905, and 1906; the geology is by L. M. Prindle, who has worked in this general field in 1903, 1904, 1905, and 1906. Mr. Prindle was assisted in his geologic work in 1904 by Frank L. Hess and in 1905 by Adolph Knopf. The present writer, who crossed this

region in 1902, has added some features to the geologic map, and also material regarding developments in the Fairbanks and Rampart regions during 1907. Mr. Prindle has presented the salient features of the geology, so far as known, in simple language devoid of technicalities. A more elaborate discussion of the scientific results is in preparation. A section by F. L. Hess on the placers of the Rampart region, which was originally printed in Bulletin No. 280, "The Rampart gold placer region, Alaska," is here reprinted, in order that all the placers in the region indicated by the maps may be covered in the written description.

As the publication goes to press, it has been possible to add to it the preliminary statement of C. C. Covert on the water resources of the Fairbanks region, based on surveys made in 1907.

THE FAIRBANKS AND RAMPART QUADRANGLES, YUKON-TANANA REGION, ALASKA.

By L. M. Prindle.

INTRODUCTION.

The Yukon-Tanana region is the area extending westward from the International boundary between Yukon and Tanana rivers to their confluence. The greatest east-west dimension of this area is about 300 miles, the greatest north-south dimension about 175 miles. The gold placers of Fortymile, Birch Creek, Rampart, and Fairbanks are situated in this region, and their economic importance has led to several years' work by the Geological Survey in making topographic and geologic maps and in studying conditions in the gold-producing regions.

A topographic map of the Fortymile quadrangle was made by E. C. Barnard in 1898 and was included in a preliminary report on the gold-producing regions.[a]

In 1903 a comprehensive scheme for mapping the entire remaining area was planned by A. H. Brooks, geologist in charge. In view of the facts that the Alaska surveys are for the most part of a reconnaissance character and that the region is thinly populated, the unit of publication adopted (see fig. 1) is a quadrangular area embracing 4 degrees of longitude and 2 degrees of latitude. The first of these maps, that of the Circle quadrangle, which was made by parties under the direction of T. G. Gerdine and D. C. Witherspoon, was published in 1906 in a bulletin of the Survey.[b] The maps of the Fairbanks and Rampart quadrangles (Pls. IV and V, in pocket), with topography by D. C. Witherspoon and R. B. Oliver, are published with this report. The area mapped on the Fairbanks sheet extends westward from the western edge of the Circle quadrangle to the 150th meridian, and the mapping has been continued northward to the

[a] Prindle, L. M., Gold placers of the Fortymile, Birch Creek, and Fairbanks regions, Alaska: Bull. U. S. Geol. Survey No. 251, 1905.

[b] Prindle, L. M., The Yukon-Tanana region, Alaska; description of Circle quadrangle: Bull U. S. Geol. Survey No. 295, 1906.

and for 1906. Additional material obtained by Brooks and Covert in 1907 has been added. The description of the Rampart region is taken largely from a Survey bulletin,[a] and as that report is now out of print the account of the placers, by Frank L. Hess, is here reprinted. This account is supplemented by data obtained by Mr. Brooks in the Rampart region.

GEOGRAPHY.

The area under consideration in the two quadrangles, about 14,000 square miles, is bounded by the 146th meridian and Yukon and Tanana rivers and has about the shape of an equilateral triangle, whose eastern side is the 146th meridian and whose western angle is at the confluence of the two rivers. The area is made up of ridges and valleys bordered on the north by a part of the Yukon Flats, deeply embayed on the south by the Tolovana Flats, and terminated on the west by the low area between the two rivers.

The dominant type of country is one of ridges more or less uniform in height, with altitudes of 2,000 to 3,000 feet, separated by valleys of equally uniform depth, but certain areas, like the White Mountains and, 50 miles farther west, the group of hills near Rampart, attain altitudes of 4,000 to 5,000 feet or more, and these areas are accentuated on the maps by the greater number and more closely crowded character of the contour lines that represent their slopes. The country between these two main features comprises many ridges, which are in general higher toward the northern part of the area and break off abruptly to the Yukon Flats or Yukon River. The southern limit of the hill country is less abrupt, and the ridges merge more gradually into the valleys of the Tanana and its tributaries. The valleys exhibit much variety; some of them are deep, steep walled, and narrow, with but little floor; others have well-developed floors and gentler slopes, and others become extensive flats. Some of them are complexly interwoven and follow most tortuous courses before leaving the hills and joining the main lines of drainage. The important tributaries of the Yukon are Beaver, Hess, and Minook creeks; those tributary to the Tanana are the Salcha, Chena, and Tolovana rivers and Baker Creek.

The Yukon Flats extend far northward from the base of the ridges to the plateau country fronting the Rocky Mountains. The sparsely timbered surface is somewhat uneven and broken where minor ridges run out into it from the base of the hills. It is dotted with a few small lakes, and the small streams that furrow the northern slopes of the hills cross it in rather ill-defined valleys. Distant shimmering

[a] Prindle, L. M., and Hess, F. L., The Rampart gold placer region, Alaska: Bull. U. S. Geol. Survey No. 280, 1906.

lines and crescent-shaped areas of water indicate the many interlacing channels of the Yukon which are spread widely over this great flat. The lowlands of the southern border, the Tolovana and Baker flats, are embayments from a similar great flat that forms a large part of Tanana Valley.

The main features of the surface can be learned from the topographic maps and need no further comment in the text. The relief, the drainage, the relations of the various drainage systems to each other, the grades of the streams, the comparative elevations and grades of different valleys are all brought out on the maps, and many of their economic relations are thus made clear to those who read the maps with care. If, for example, the digging of a ditch or the construction of roads or railways is under consideration, the most feasible routes can be approximately determined by a study of the maps.

The explanation of the uniformities in altitudes is to be found in the history of the region. The ridge level is a remnant of a former continuous more or less uniform surface lying at a lower altitude near sea level. Subsequent elevation has resulted in the cutting of the present valleys. The explanation of local differences of relief, like that of Pedro Dome with its surroundings or the White Mountains in the Fairbanks region, or Wolverine Mountain in the Rampart region, is to be found largely in differences in the character of the bed rock that are accentuated under the conditions of the present downcutting. The local granitic intrusives in Pedro Dome and Wolverine Mountain have withstood erosion and held up these areas, and the limestone of the White Mountains performs the same function.

Stream adjustments are also clearly shown on the map. An example may be taken from the Beaver Creek system. One of the small tributaries draining the southern part of the White Mountains has been called, for purposes of description, Fossil Creek, from the occurrence of fossiliferous limestone pebbles in the gravels. East of the single narrow limestone ridge that terminates the White Mountains is a parallel ridge of shorter extent. Between the two lies a low-grade valley, 2 miles wide, extending northeastward for nearly 10 miles and drained by a stream that flows along its western side close to the base of the limestone ridge. From the base of the ridge on the east, broad, flat spurs, separated by open depressions so shallow as to be hardly noticeable, extend westward to the stream. On close examination the apparently continuous valley is seen to be composed of two parts—a lower, drained by a stream which seems disproportionately small for the size of the valley and which has its rise in a few small stagnant ponds strung longitudinally along its course about 5 miles from Beaver Creek, and an upper, drained by a stream of about the same length, which flows at first southwestward, in line

with the stream of the lower portion of the valley, and then turns abruptly westward to Beaver Creek through a narrow canyon that interrupts inconspicuously the continuity of the limestone ridge. This upper part of the valley has been reduced somewhat below the level of the lower part, but not to an extent appreciable in a general view. It is an example of stream diversion, a minor tributary of the Beaver having cut through the limestone ridge and diverted to itself the waters of the upper portion of a valley that formerly drained southwestward along the entire eastern base of the limestone ridge. The diversion of the drainage from the upper valley has weakened the stream that occupies the lower portion, and its forceless character is indicated by the string of small ponds along its present headwaters.

The streams, therefore, are by no means permanent, independent units of drainage, but are most delicately adjusted and may in their development encroach upon one another's drainage areas.

CLIMATE AND VEGETATION.

Owing to the high latitude of the area, 65° to 66° north, there are great differences in the characteristics of winter and summer. The annual range of temperature is great. At Tanana, for the period from August, 1901, to December, 1902, the temperature varied from 76° F. below zero in January to 79° F. above zero in August. The intense cold of winter is not accompanied by excessive snowfall, but the water circulation is reduced to a minimum and the long continuance of such conditions has resulted in freezing to great depths a large part of the superficial deposits. But even during the winter, when the larger streams are covered with ice up to 6 feet thick, a considerable amount of water is in circulation, and it frequently breaks through the ice, causing overflows. Many small streams thus form thick accumulations of ice that may remain throughout much of the summer. The ice begins to go out of the Yukon at Tanana at dates varying in different years from about May 10 to May 15, and a few days later the river is clear. Mush ice begins to run at dates varying from October 15 to 25, and in from one to two weeks later the river is generally closed to navigation. The Tanana at the mouth of Baker Creek froze October 20, 1905, and the ice went out May 6, 1906. The summers are characterized essentially by conditions like those in temperate latitudes, except that the sun is above the horizon a much larger portion of a summer day than in more temperate regions and that the season itself is short. The summer advances rapidly from the time of the break-up of the ice, the days become hot to a degree comparable with those of regions much farther south, and generally no killing frosts occur till about the first of September. The mean annual precipitation in the interior of Alaska, including both

melted snow and rain, is not great. Observations taken at Tanana at intervals from 1882 to 1886 gave an annual average of 15.45 inches. The rainfall varies greatly in the different seasons; sometimes long continued drought lowers the quantity of water in the streams below the economic limit, while in other seasons water is almost constantly in excess of the amount required. A detailed statement of the water supply and rainfall, by C. C. Covert, is given on pages 51–59 of this report.

The distribution of vegetation is shown in fig. 2. The high ridges are mostly bare of trees and are covered only with the low vegetation

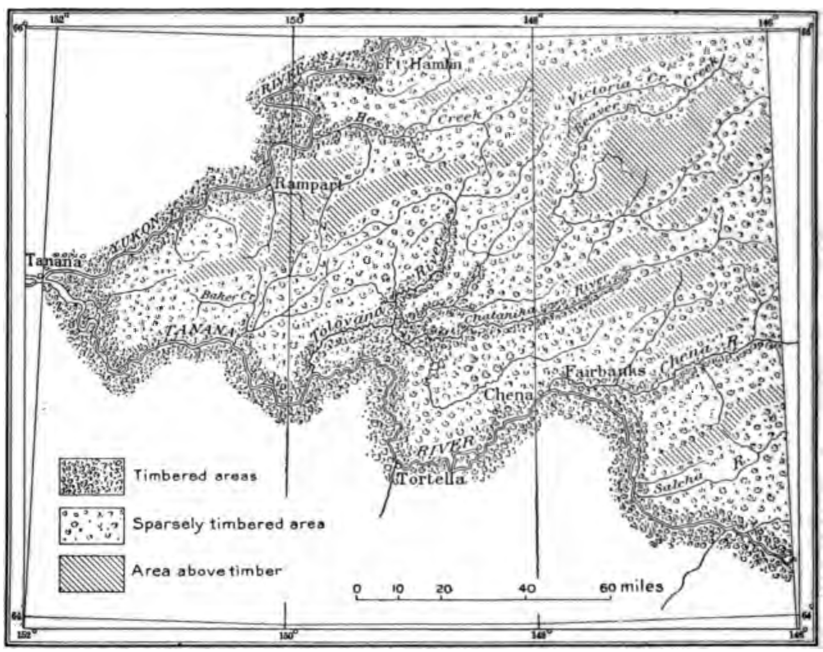
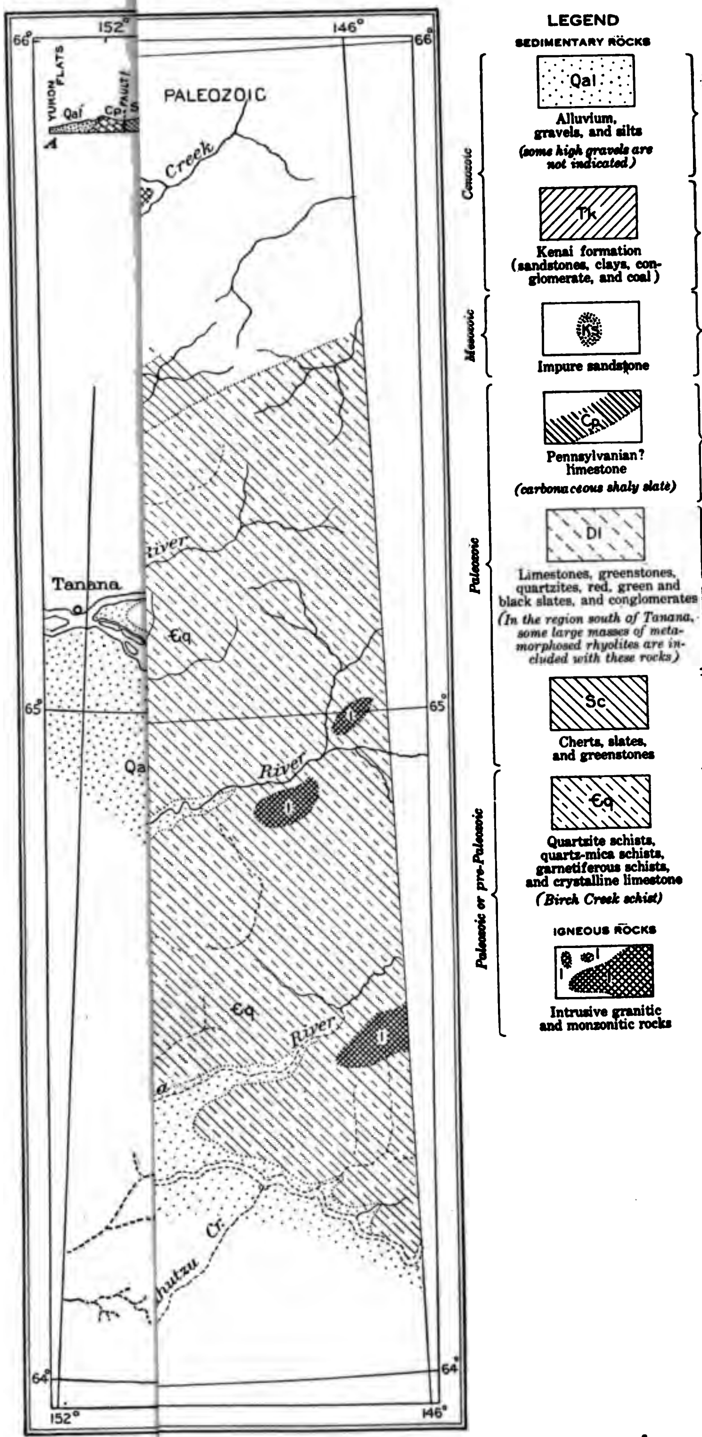


FIG. 2.—Map showing distribution of timber in the Fairbanks and Rampart quadrangles.

of the tundra. The lower ridges are largely covered with a dense growth of small spruce, accompanied by birch and poplar and in the larger valleys by a small proportion of tamarack. Willows and scrub alders grow abundantly near the streams. Good timber is confined to the larger valleys, where it is most thickly concentrated in scattering patches along the streams. Spruce is the most important tree and attains in many places a diameter of 2 or more feet.

The valley sides and lower ridges of the Fairbanks region are covered with a light growth of spruce and poplar, and fine patches of birch are common on the hillsides facing the Tanana. Good timber is reported from the lower valleys of the Chatanika and Tolovana.

U. S. GEOLOG BULLETIN NO. 337 PL. I



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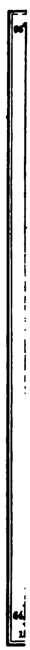

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The low ridges forming the eastern side of Beaver Valley east of the White Mountains present in places the appearance of a well-timbered country, but on closer view are found to be covered with only a thick growth of small spruce. The upper valley of Hess Creek and the valleys of its tributaries contain also abundant small spruce, with some larger timber near the streams. The valley of Minook Creek has contained considerable timber of sufficient size for mining purposes, but only a small amount of such timber is left. The valleys of the southern slope facing the Baker flats contain but little timber of large size, but some good timber is reported to be present in the valleys of Hutlina and Baker creeks. On the hillsides near the Baker Hot Springs is a luxurious growth of birch and poplar. Timber for fuel purposes is abundant in most of the valleys and lower slopes throughout the region.

Feed for horses can be found on the sunward-facing slopes of most of the main valleys and there are large grass-covered areas in the Tolovana flats. Blueberries are almost everywhere to be found in abundance on the open hillsides and valleys, and locally currants, cranberries, and red raspberries are sufficiently abundant to be of practical importance. Most of the hardy vegetables can be grown successfully, and at Hot Springs they are produced in large quantities and sold to the miners of the Fairbanks and Rampart regions.

DESCRIPTIVE GEOLOGY.

GENERAL STATEMENT.

The area covered by the maps is composed essentially of two rock groups, for the most part widely different in characteristics. (See Pl. I.) The members of the one are highly schistose and are predominantly quartzite schists and quartz-mica schists, with some crystalline limestone and greenstone. The members of the other are predominantly carbonaceous slate and coarser fragmentals, chert, greenstone, and limestone. The older group is the schists, which are characteristically developed in the Fairbanks, Birch Creek, and Fortymile regions and are the oldest rocks known in the Yukon-Tanana region. Their age has not been definitely determined, but they are probably older Paleozoic or pre-Paleozoic. The younger group is characteristically developed in the Rampart region and in areas farther east, including the White Mountains. Rocks provisionally correlated with them occur also south of the Tanana. Their age is Paleozoic, for fossils determined as possibly Silurian, as Devonian, and as Carboniferous have been found in them. The main line of demarcation between the two groups extends northeast and southwest in the area between the White Mountains and the

ridge limiting on the northwest the valley of the Chatanika. A small area of the older rocks occurs also in the Rampart region. Although the two groups have not been found in unconformable contact there was probably a long time interval between the deposition of the two, and the difference in the degree of their metamorphism is sufficiently great to constitute a metamorphic unconformity of stratigraphic value. The general strike is northeast and southwest, and the rocks wherever observed are closely folded. There are small areas of later rocks, probably not older than the Cretaceous; slightly consolidated sediments of Tertiary age; and unconsolidated Pleistocene and Recent alluvial deposits. Granitic and more basic intrusives are common in both of the older groups, and greenstones are especially abundant in them. Fresh volcanic rocks occur to a slight extent in the vicinity of Rampart and metamorphosed rhyolites are present in the area south of the Tanana.

The following tabular statement is based only on reconnaissance trips and is therefore of a preliminary nature. The variety of rocks, the complexity of structure, and the paucity of paleontologic material in the areas studied render possible only the barest outlines of the stratigraphy. The areal distribution of the rocks is shown on the geologic map (Pl. I). The predominant lines of structure are well exhibited by the areal development of the rocks, and the formation occurring in the White Mountains finds its continuation most probably in the rocks outcropping along the Tanana between the mouth of the Kantishna and that of Baker Creek.

Provisional tabular statement of stratigraphy of Fairbanks and Rampart quadrangles.

	System.	Series.	Period or formation.	Lithologic character.
Cenozoic	Quaternary	Recent		Stream gravel.
		Pleistocene		Bench gravel.
	Tertiary	Eocene	Kenai	Slightly consolidated conglomerate, sandstone, and consolidated clay.
Mesozoic	Cretaceous			Black carbonaceous sandstone and slate.
Paleozoic	Carboniferous	Permian or Pennsylvanian.		Gray, greenish, and black shale with thin siliceous beds.
	Devonian and possibly older rocks.			Gray and blue, partly siliceous limestone, greenstone, quartzite, red, black, and green slate, conglomerates, and finer fragmentals and interbedded limestones.
	Silurian (?)			Chert, slate, greenstone, and limestone.
Metamorphics (Paleozoic or pre-Paleozoic.)			Birch Creek schist.	Quartzite schist, quartz-mica and garnetiferous schist, greenstone schist, and crystalline limestone.

STRATIGRAPHY.

METAMORPHICS (PALEOZOIC OR PRE-PALEOZOIC).

The rocks characterized as metamorphics were, for the most part, originally sediments, including sandstone, shale, and a small proportion of limestone. This material, through various processes included under the term metamorphism, has all been more or less changed until it now exhibits characteristics of structure and composition that differ greatly from those of the original rocks. Of the new minerals formed mica is the most generally distributed, and its extensive development in nearly all the rocks under consideration has imparted a schistose character to them. They split readily along the planes parallel to the cleavage of the micas, and are easily recognized as schists by the miners who are working in the areas where this older group forms the bed rock. These rocks in places have been but partly metamorphosed and retain many characteristics of their sedimentary origin. Some of the quartzitic rocks, for example, contain but a small proportion of mica and are but slightly schistose. In a more advanced stage of metamorphism, however, there is a more or less complete rearrangement of material by solution and recrystallization, until the rock that owed its characteristics originally to sedimentation becomes one with most of its characteristics due to entirely different processes. In the same way igneous rock, originally formed by consolidation of molten material, may lose the structure, texture, and mineral composition characteristic of its mode of origin and take on those of metamorphism.

In a region of metamorphic rocks, therefore, rocks of both sedimentary and igneous origin may be present as schists. In the eastern part of the Yukon-Tanana region, metamorphosed igneous intrusives form an essential part of the metamorphic assemblage. In the western part of the area, however, including the Birch Creek and Fairbanks regions, the schists are predominantly of sedimentary origin and include quartz schists, quartz-mica schists, feldspathic, carbonaceous, garnetiferous, and hornblendic schists, and crystalline limestone.

The structure of the rocks is complex. The trend or strike, where the bedding is inclined at a considerable angle or is vertical, is in most places northeast and southwest. The rocks are so closely folded in some places that the sides of the folds are approximately parallel, and the planes of their axes are commonly so nearly horizontal as to make the whole assemblage appear level or horizontal. Quartz veins are common throughout the schist areas. They are generally small, occurring as stringers from a fraction of an inch up to a few

feet in thickness, but are so numerous as to form probably a considerable proportion of the entire mass.

Although the proportion of metamorphosed igneous material is small, fresh granitic intrusives are rather common and occur as irregular masses up to a few miles in diameter, fringed with dikes that complicate the structure of the schists. The elaborate system of repeated intrusion, so extensively developed in the Fortymile region, with its far-reaching metamorphic effects, has not extended to the area under consideration.

The western limit of the metamorphics is in the ridge northwest of the valley of the Chatanika. This ridge is formed of quartzitic schists, with some carbonaceous schists and crystalline limestone. A few miles nearer Beaver Creek, at the ends of spurs extending laterally from this ridge toward Beaver Creek, there are outcrops of less-metamorphosed feldspathic quartzite that is included in the later group. A small area of garnetiferous schist with associated crystalline limestone occurs in the Rampart region on Minook Creek and is included in the Birch Creek schist.

PALEOZOIC ROCKS.

SILURIAN AND DEVONIAN.

Between the two areas of schists above described, one the westward extension of the schists of the Fairbanks region, the other a small area whose limits are not known, lie rocks most of which are regarded provisionally as Silurian and Devonian. The bulk of the formation, as already mentioned, is made up of cherts, slates with alternating beds of conglomerate, finer fragmentals, limestones, and greenstones. These rocks may be roughly divided into two groups according as cherts, slates, and greenstones, or conglomeratic rocks with massive limestones, greenstones, slates, and quartzites predominate. It is believed that those forming the first division are older. The term "Rampart series" has been used by Spurr[a] in grouping similar rocks occurring in other parts of the Yukon-Tanana country. In those areas, however, diabase, tuffs, and green slates are most abundantly developed, and carbonaceous slates and limestones, though frequently present, are of minor importance. In the areas under consideration, while greenstones are found throughout the assemblage, black slates, cherts, and massive dark and light-gray limestones are more common and more strikingly characteristic. A section of these rocks is crossed in traveling from Chatanika River northward to the southern edge of Yukon Flats, a distance of about 60 miles, and this section, though incompletely studied, has afforded some information in regard to the structure and age of the rocks composing it.

[a] *Spurr, J. S.*, Eighteenth Ann. Rept. U. S. Geol. Survey, pt. 3, 1897, pp. 155–169.

The general strike in the southern part of the section is about N. 50° E., and it is instructive to note that the direction of structure so strongly emphasized topographically in the Alaska Range is here repeated. In the northern part of the section the strike is more nearly east and west. The rocks are closely folded and in most cases their attitude is nearly vertical. There is a distinct symmetrical arrangement with reference to a northeast-southwest axis, and, so far as our present knowledge extends, this symmetrical disposition of the rocks seems to be a fact of importance in regard to their structure and succession. This repetition is most noticeable in the occurrence of limestone. The limestones of the White Mountains, with associated greenstones, flanked on the northwest by red and black slates and prominent masses of impure quarzite, are repeated 15 miles to the north in another limestone belt, less conspicuous topographically than that of the White Mountains, with a similar association of rocks, and flanked on the northwest by similar slates and quartzites. The rocks of the middle portion of the section are slates, greenstones, and cherts, and, although the relations are not clear, there are two main areas of cherts about 3 miles apart, with black, purple, and greenish slates and some greenstones in the intervening space. North of the northern belt of cherts, toward the northern belt of limestones, there are conglomerates containing abundant chert pebbles. Farther south, toward the limestones of the White Mountains, there are also chert conglomerates with pebbles an inch or more in diameter, associated with finer rocks containing grains of chert and fragments of slate. Black slates are also common and thin beds of conglomerate are interbedded with them. The slates are closely succeeded by the limestones on either side, and although the direct relation of the two kinds of rock was not observed, it is believed that the limestones are younger than the rocks above described. The quartzite flanking the limestone on the north, which is very similar to other quartzites apparently interbedded with the limestones, contains occasional fragments of chert, and it seems best until further knowledge is available to consider the flanking slates and quartzites as partly of the same age as the limestones and partly younger.

Fossils found in the limestones of the White Mountains have been determined as characteristic of early to middle Devonian, and some of them are possibly of Silurian age; but the stratigraphic association makes it probable that all the remains belong approximately to the same horizon, and the determinations point more definitely to the Devonian. No fossils were found in the limestones of the northern belt, but the rocks and their associations are very similar, and no reasons were found for assigning them to a different position.

The contact relations of these rocks with the Carboniferous rocks north of them and the metamorphics south of them are not clear.

At the north end of the section, fossils determined as Pennsylvanian or Permian were found in a low, outlying ridge overlooking the flats. South of these are black slates and cherts at the base of a high ridge, the topmost points of which are quartzites containing occasional chert pebbles interbedded with red and black slates and some dark limestones. The relations with the metamorphics on the south were not observed.

The evidence at hand seems sufficient to justify only the statement that in the section from Chatanika River to Yukon Flats there is a large area of closely folded rocks, in part of Devonian age and in part probably older, flanked on the south by highly metamorphosed schists and on the north by shaly slates containing Carboniferous fossils.

In the Rampart region a variety of rocks like those already described is found. These rocks have undergone greater disturbance and have been more generally intruded by igneous material. They have been closely folded; many of them have been greatly sheared and in some places brecciated. The strike of the rocks is nearly east and west. The garnetiferous mica schists and marbles of Ruby Creek, considered pre-Ordovician, are followed on the north by cherts and greenstones and on the south by rocks including slate, chert, sheared chert conglomerate, fine-grained rocks having the same composition as the chert conglomerate and also sheared until they have been rendered schistose, massive quartzites, and siliceous limestones, in places much brecciated. Here, also, the succession seems to be from chert and slates through chert conglomerate to fine slate and limestone.

A partial succession has been observed in other localities in the Rampart region. The main divide east of Lynx Mountain is composed mostly of chert flanked by chert conglomerate, and at one locality near the southeastern base of Lynx Mountain there are fine exposures showing at the base a conglomerate containing sheared chert pebbles several inches in diameter, changing gradually to alternating beds of finer material. Gray slates, highly folded and cleaved and pitching eastward, were observed not far from this locality. These slates contain thin beds of quartzite, a few inches to a foot or more thick, which contain grains of chert.

In Troublesome Valley the succession seems to be the same. A section southward between Troublesome and Hunter creeks shows greenstones, cherts, sheared chert conglomerate, and slates, with disconnected limestone masses in which fossils determined as Devonian were found. The chert conglomerates are at many places found in close association with the limestones, and at the locality where Devonian corals were collected conglomerate with chert and quartz pebbles is

found in close association with the limestone, which also contains quartz pebbles.

Most of the rocks encountered in the Rampart region form a continuation along the strike of those occurring in the section from the White Mountains nearly to Yukon Flats. The same lithologic types and the same associations are found, and, so far as the meager fossil evidence is available, it corroborates the relationship of the rocks in the two areas. Similar rocks are developed south of Tanana River, where extensive masses of altered rhyolite occur with them. This correlation is based on lithologic and stratigraphic evidence alone.

The fossils collected by the Survey in 1904 are mentioned in the following list. The determinations were made by E. M. Kindle, of the United States Geological Survey.

Fossils from the White Mountains.

4 AP 240. This lot contains two corals, a *Michelina* and a *Zaphrentis*, neither of which is specifically determinable. Horizon probably Devonian.

4 AP 241. *Favosites* near *epidermatus* occurs in this collection indicating a horizon of Middle Devonian age.

4 AP 242. Specimens of a coral comparable with *Favosites winchelli* comprise the collection from this locality. Horizon probably Middle Devonian.

4 AP 243, 245, and 246. These lots represent the same horizon. The fauna represented in the collection comprises a single species of brachiopod *Gypidula* cf. *pseudogaleatus*. The horizon represented is either late Silurian or early Devonian, probably the latter.

4 AH 186. Includes only poorly preserved specimens of *Cladopora*. Probably of Middle Devonian age.

4 AH 193. The fossils represented are *Cytherella* sp., *Cladopora* sp., and *Ptilodictya ?* cf. *frondosa*. The horizon is probably Silurian.

4 AH 194. *Favosites* near *limitaris* occurs in this lot, indicating a horizon probably near Middle Devonian.

4 AH 195. Contains an undetermined *Stromatopora*. Age probably Devonian.

Fossils from the Rampart region.

4 AP 303. Two poorly preserved specimens of *Aulacophyllum* comprise this lot. The horizon represented may be either Devonian or Silurian so far as the evidence from this material indicates.

4 AP 317. Minute fragments of small corals in a breccia comprise this lot. Fossils too fragmentary for determination of the age.

Additional material from the Rampart region collected during 1907 was also referred to Mr. Kindle, and the following is quoted from his report:

7 AP 277 (Quail Creek). This lot contains several species of corals and fragmentary representatives of a large lamellibranch and a gasteropod. They are referred provisionally to the following genera:

Cladopora?	Diphyphyllum.
Syringopora.	Megalomus??
Amplexus?	Pleurotomaria?
Streptelasma?	

The minute characters used for specific limitation in corals are not well enough preserved to justify any attempt at the specific determination of the corals. Since the genera noted above are all common to both Devonian and Silurian horizons, they afford no definite evidence as to which of the two the corals represent. The chief interest of the collection lies in the lamellibranch fragments, which represent a very large, thick-shelled form that appears almost certainly to be specifically identical with a shell occurring in the limestones of Glacier Bay and similar beds at Freshwater Bay in southeastern Alaska. This southeastern Alaska shell has been referred to the genus *Megalomus* and considered to belong to a late Silurian fauna.

7 AP 318 and 7 AP 320 (Head of Little Minook Creek). This material has yielded four or five species of brachiopods, represented by very poor fragments, so that even approximate determination is difficult. They may be tentatively referred to the following genera:

Chonetes?	Amphigenia?
Stropheodonta.	Rhipidomella?
Delthyris?	

The determination of *Stropheodonta* is based on a fragment of a single valve, but the distinctly denticulated hinge line leaves but little doubt of the correctness of this generic determination. This genus is unknown in the Carboniferous "and is emphatically characteristic of the Devonian." *Amphigenia*, which is believed to be represented by a fragmentary mold of a pedicle valve, is also limited to the Devonian. The specimen referred to *Delthyris?* is unique in its ornamentation and may possibly belong to another genus. There are also two other doubtfully determined genera of brachiopods, represented by fragments. The small gasteropods, which are represented by molds belonging to two or three species, contribute no evidence as to the age of the fauna. Although more and better material is needed to determine the horizon with certainty, it is believed that the forms determined as *Stropheodonta* and *Amphigenia?* necessitate placing the fauna in the Devonian, at least provisionally.

The occurrence of this fauna in conglomerates interbedded with black shales leads me to believe that it belongs near the top of the Devonian of the Yukon section, in beds corresponding to the black shales of the Calico Bluff section.

The fauna is quite unlike any other Alaskan fauna which has come under my observation, but for the reasons already stated it should, in my judgment, be placed provisionally in the Devonian.

CARBONIFEROUS.

At the extreme northern limit of the hill country, in a minor ridge bordering Yukon Flats, there are greenish, grayish, and black slates, with siliceous material, scattered fragments of which were found to contain fossils indicating a Pennsylvanian or Permian age. At another locality, about 15 miles farther southwest, just south of Hess Creek, fossils also regarded as Carboniferous were found in soft, black carbonaceous shales. At both localities the rocks are in close association on the south with cherts and slates. It is possible that there is a fault between the two formations, and the relation is so represented in the section. All that can be affirmed at present is that in the northern part of the area there occur Carboniferous rocks,

whose extent and relations to the rocks of Devonian age are not yet determined.

The following fossils, determined by G. H. Girty, were collected at the two localities, and the discussion of them is quoted from his report:

Fossils from near Yukon Flats and from Hess Creek, Alaska.

4 AH 213.

Stenopora 2 sp.
Fenestella sp.
Rhombopora sp.
Rhombopora sp.
Productus? sp.
Lima? sp.

4 AP 270.

Fistulipora sp.
Stromatopora? sp.
Coral sp.
Fistulipora sp.
Fistulipora? sp.
Rhombopora sp.
Rhombopora sp.
Spirifer n. sp.?
Hustedia cf. H. compressa Meek.

4 AP 277.

Coral? sp.
Lithostrotion? sp.
Fistulipora 3 sp.
Rhombopora sp.
Polypora? sp.
Archimedes? sp.
Productus sp.
Euomphalus sp.

The presence of the form identified as *Hustedia compressa* seems to show that lot 270 belongs in the Pennsylvanian, perhaps in the "Permo-Carboniferous." The ages of the other lots, although without much doubt being Carboniferous, are less certain. While probably no species is common to all three collections, yet in a general way the facies is much the same, and it is quite possible that all represent the same fauna.

It will be observed that only in one case have the forms collected been identified specifically. In many instances the material is too imperfectly preserved to admit of more than the genus being determined. In others the species are distinct from those of the Mississippi Valley sections, and entirely new unless some of them have been described in European and Asiatic publications not included in my bibliography and therefore difficult of reference.

I have consulted freely with Mr. Bassler wherever the Bryozoa were concerned.

MESOZOIC ROCKS.

CRETACEOUS.

On the flanks of Wolverine and Lynx mountains there are black, rather massive, carbonaceous sandy shales. In those of Wolverine Mountain, which form great rock piles along the upper parts of the spurs at an altitude of over 1,000 feet above the base of the mountain, there were found in 1905 fragments of dicotyledonous leaves and a part of an indeterminable bivalve, and on this basis the rocks were assigned to the Cretaceous. The Lynx Mountain rocks are correlated on only lithologic grounds.

During 1907 additional material was obtained and referred to Dr. T. W. Stanton for determination. The following is quoted from his report:

While the fossils are fairly well preserved, they have been considerably distorted, so that it is not practicable to make specific determination. The better preserved forms appear to be undescribed. The following list will show the forms recognized in each lot:

4278. 7 AP 271 (Spur of Wolverine Mountain).

Hemiaster? sp.	Lucina sp.
Pecten sp.	Pleuromya sp.
Inoceramus cf. labiatus Schloth.	Pachydiscus sp.
Cucullæa sp.	Pachydiscus? sp.

4279. 7 AP 278 (Ridge on left limit south fork of Quail Creek).

Hemiaster? sp.	Pachydiscus sp.
Cucullæa sp.	Pachydiscus? sp.

4280. 7 AP 279 (Right limit south fork of Quail Creek).

Pachydiscus sp.

These fossils evidently all belong to practically a single horizon which is confidently referred to the Upper Cretaceous. * * * The species of *Inoceramus* is very likely one that has been previously found on the Yukon, but the specimens in the present collection are too imperfect to serve as the basis for a positive identification. The most important forms are ammonites, which make up the bulk of the collection and which I have referred, in some cases doubtfully, to the genus *Pachydiscus*. These are unquestionably Upper Cretaceous types.

These Cretaceous rocks have been abundantly intruded by dikes of granular igneous rocks of intermediate composition that are described below and, furthermore, are much seamed with small quartz veins, many of which are ferruginous.

CENOZOIC ROCKS.

TERTIARY.

Rocks determined as Kenai (Eocene) occur along the Yukon above Rampart and are found also for a short distance up the valley of Minook Creek, where they contain a small amount of coal. They are conglomerates, sandstones, and clays resting unconformably upon the older rocks. In some places they are hardly consolidated sufficiently to withstand the pick, and prospect holes have been sunk into this formation under the impression that the material belonged to the stream deposits. These rocks are tilted but otherwise are little changed. The same formation is found in considerable areas south of Tanana River (see Pl. I), where it carries some good lignitic coal seams.

QUATERNARY.

The changes in elevation with reference to sea level which the Yukon-Tanana country has undergone have left benches at various altitudes, some of them of considerable extent, which stand generally in a definite relation to the present drainage lines. Gravel was deposited on some of the benches during their formation. Part of this gravel is regarded as of Pleistocene age.

Such deposits have been found in the Fairbanks region in the valley of Fairbanks Creek, and in the Rampart region along Hess Creek and its tributaries, along the Minook, and along the tributaries of Baker Creek. The deposits of the high bench of the Minook, approximately 500 feet above the present stream, are of interest with reference to the occurrence of gold in the tributaries of Minook Creek. The bench gravels of the Baker drainage have proved in some places to be of great economic importance. The description of these gravels and the deposits of the present streams is given elsewhere in this report in the account of the gold placers.

Silts also have accumulated in great quantities in the larger valleys throughout the interior of Alaska, and as gravels have been repeatedly deposited on successively lower benches, so, too, silts have been deposited at different levels down to that of the present flood plains. These were probably laid down under lacustrine conditions and the interaction of lacustrine and fluviatile conditions, and the age of deposition dates from the Pleistocene, or earlier, to the present time.

IGNEOUS ROCKS.

In the geologic history of the Yukon-Tanana region igneous rocks have played a very important part, and though not so widely distributed in this western part of the area they form nevertheless an essential part of the bed rock.

The igneous rocks include material that in a more or less molten condition has penetrated the other rocks in various forms at various times and at various depths below the contemporary surface and also material that has been poured out upon the surface as lava flows or has been ejected as fragmental material. The rocks formed by the consolidation of the molten material have characteristics so indicative of their origin that miners generally distinguish with little difficulty the igneous from the sedimentary rocks with which they are associated, or the igneous material present in the gravels from the sedimentary material with which it is mixed.

The differences in the composition of the igneous rocks are not so readily observed. Coarse-grained, fine-grained, and glassy rocks entirely different in appearance may result from the same material solidifying under different conditions, and furthermore, the igneous

material from which the rocks are derived has a wide range of chemical composition, and the rocks that result from its solidification present a great variety of mineral composition and many gradational types. Therefore, no hard and fast lines can be drawn between the kinds of igneous rocks resulting from solidification through more or less complete crystallization. Furthermore, some of the igneous rocks, since their solidification, have been greatly changed by metamorphism along with the sedimentary rocks with which they are associated, and their original characteristics have been more or less obscured by the processes that have altered them. For the purposes of this brief report the igneous rocks of this area need to be considered only in a very general way. For sake of convenience they are divided into granitic rocks, monzonitic rocks, greenstones, and basalts.

GRANITIC ROCKS.

Intrusive biotite granite and hornblende granite occur in parts of the Fairbanks region, notably in the ridge south of Gilmore Creek, on Twin Creek, Pedro Dome, and at the head of Chatham Creek. The rock of some of these localities is porphyritic with feldspar crystals an inch or more in diameter, and that at other localities is fine and even grained. The rocks are fresh and have not undergone the metamorphism that has altered the schists. Intrusive gneisses, such as are common in the Fortymile region, were not observed, nor are the injection zones that are so common in the Fortymile country present in this western part of the Yukon-Tanana region. There are a few areas of coarse-grained biotite granite in the northern part of the region, near the head of Beaver Creek and between Beaver and Victoria creeks. Another area is located on the southern side of the divide, near the head of the Tolovana drainage. These intrusive masses were probably injected during Mesozoic time.

Granitic rocks are not of common occurrence in the Rampart region. The most extensive mass observed forms a part of the summit of Wolverine Mountain, where it occupies an area about 1,000 feet wide. It is a porphyritic, massive, gray rock composed chiefly of quartz, phenocrysts of orthoclase a half inch or more in diameter, considerable plagioclase, some biotite and hornblende, and a little pyroxene. The rock is finer grained toward the margin; the slates in contact with it have been indurated, and their fracture surfaces are flecked with the products of metamorphism, chiefly andalusite.

A similar rock occurs west of the mountain near the saddle where the trail passes through the ridge to descend toward the Hutlina. This is also a gray porphyritic rock, but the porphyritic feldspars, some of them an inch or more in diameter, have a tabular development. The proportion of pyroxene is greater, there is less quartz,

and the composition of the rock is transitional to that of the monzonitic rocks. Rocks similar in composition to those of Wolverine Mountain occur also in Lynx Mountain along with monzonitic rocks, but their outcrops were not observed.

A porphyritic biotite granite is found in the vicinity of Baker Hot Springs, where it is intrusive, in black carbonaceous slates.

MONZONITIC ROCKS.

The most common intrusive in the Rampart region is a monzonitic rock that varies in color from dark brown to nearly black. It is a medium to fine-grained rock, and the coarser varieties show abundant plates of reddish-brown mica, the most striking mineral present. All the minerals of this rock are fresh and include about equal proportions of an orthoclase feldspar and of plagioclase, which is embedded in the irregular limpid mottled grains of potash feldspar, abundant pale-green monoclinic pyroxene, biotite, and a small proportion of olivine. Hypersthene occurs frequently, its small prisms often fringing the grains of olivine, at the expense of which it has probably been formed. There is some apatite and often much magnetite.

This rock occurs in Lynx Mountain and in the ridge at the heads of Glenn, Rhode Island, and Omega creeks, where it forms a mass of considerable extent. The numerous small dikes of minette-like rock in the slates, from 1 foot to 3 feet thick, containing prominent plates of bleached biotite and a large proportion of nearly colorless prismatic crystals of monoclinic pyroxene, are probably to be referred to this type.

A portion at least of the granular rocks of intermediate composition in the Rampart region are intrusive in Upper Cretaceous rocks and it is probable that all of them are of the same general period.

GREENSTONES.

The greenstones include serpentine, altered gabbro, diabase, basalt, and much tuffaceous material, and have at many places been intruded by fresh diabasic rocks. Some show clearly their mode of origin, others are indefinite aphanitic chertlike rocks. They occur abundantly in the area lying between the White Mountains and Rampart. Their dark color contrasts strongly with the associated limestones of the White Mountains. They form the prominent ridges across Beaver Valley west of these mountains and occur in the area between this ridge and Yukon Flats. Farther west they become prominent in the ridge north of Hess Creek. In the Rampart region they form the bed rock in the lower part of Troublesome Valley and are the most widely distributed rocks in the lower valley of the Minook below the mouth of Florida Creek.

The greenstones are partly intrusive and partly extrusive in the rocks in which they occur. Those in association with the limestone are, so far as has been observed, parallel to the structure, and furthermore, some of them are altered basalts containing numerous amygdules filled with calcite. Diabasic intrusives cut the serpentine and in the Rampart region intrude the Rampart slates. The volcanic activity that resulted in the production of this material took place, principally at least, during the deposition of the rocks regarded as Silurian and Devonian.

BASALT.

A fresh olivine basalt occurs on Minook Creek about 1 mile above its mouth. On Hunter Creek, a short distance above its mouth, and apparently related to the basalt in their occurrence, are volcanic glasses containing basic feldspar phenocrysts. These volcanics are probably subsequent to the Kenai. A small mass of basalt was also observed in the Fairbanks region in the valley of Fairbanks Creek.

METAMORPHOSED RHYOLITES.

In the region south of Tanana River there are interbedded with the cherts and slates (Devonian?) large masses of augen gneisses which on microscopic examination proved to be altered rhyolites. These rocks range from a coarsely porphyritic gneiss with feldspars up to 2 inches in diameter to an evenly fine-grained sericite schist with no grains visible to the eye. The most common type is composed essentially of quartz and feldspar grains in a groundmass of quartz and feldspar largely sericitized. Remnants of original igneous textures are preserved, but the present structures and textures are due mostly to cataclastic action and recrystallization.

SUMMARY.

The greatest part of the area is formed of closely folded rocks striking northeast and southwest, separable into two large groups, one including highly metamorphosed schists regarded as early Paleozoic or pre-Paleozoic and the other being made up of rocks greatly variable in kind but characterized in general by a less degree of metamorphism and regarded as predominantly Silurian and Devonian. Igneous rocks are an essential constituent of the area. Some of them have been highly metamorphosed along with the sedimentary rocks that are now schists; others are fresh granitic or more basic intrusives that were probably injected at the end of Mesozoic time; and still others, which are present to a minor extent, are comparatively recent extrusives. Igneous rocks occur in all the areas that produce gold, but are not confined to these areas, and the gold occurrences are probably to be referred partly, at least, to after-effects of intrusion.

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Cleary, Fairbanks, Dome, Vault, Esther, Goldstream, and Pedro creeks and their tributaries are the chief producing creeks of the district. Cleary continues to stand first in production, with Fairbanks in second place. The finding of values on Cripple and Treasure creeks definitely extends the producing area to the southwest, and reported discoveries of gold in the upper Chena may show a northeasterly extension of the same belt, though this is not yet established.

The facts in hand are, however, sufficient to determine that there is a gold-bearing zone, at least 10 miles wide, running northeast and southwest, which has been traced for about 30 miles. Its northeastern extension would intersect the upper Chena basin, while to the southwest it runs out into Tolovana flats. A logical deduction from these facts would suggest that the prospector could turn his attention to the Chena basin and to the streams draining the upland which bounds the Tolovana flats on the east. It should be remembered, however, that the investigations so far made indicate that the conditions which bring about mineralization are local, and hence the formation of placers probably does not persist over any great distance.

Worthy of special note are the rich placers found last year on Vault Creek, which had previously been unproductive. On nearly all the producing streams which are tributary to the Chatanika the pay streak has been traced well down to the main river. In fact, the origin of the rich gravels found in various places at 100 to 200 feet depth under the valley floor of the Chatanika is among the most puzzling of the phenomena connected with the placers of this district. Interest in Goldstream Creek was revived during last summer by some rich placer discoveries, and as a result, though the creek was almost abandoned in the early part of the summer, later it was studded with operators for several miles.

Of the outlying districts tributary to Fairbanks the Tenderfoot probably made the largest production, estimated at $300,000. The gravels on Tenderfoot Creek are deep, but in the smaller creeks are said not to exceed 8 to 10 feet in depth. It would appear that these deposits lie in a different zone from those of Fairbanks.

[a] Brooks, A. H., report on progress of investigations of mineral resources of Alaska, 1906; Bull. U. S. Geol. Survey No. 314, 1907, pp. 36–37.

The greenstones are partly int·s tributary to the upper Chatanika, where rocks in which they occur. Tome gold has been found on Faith, Hope, and are, so far as has been obserreak is thin and the values are said to be regu- more, some of them are
dules filled with calc time, 1907, transportation to the Fairbanks in the Rampart re points has been by way of Dawson, St. Michael, tivity that resu Valdez route is convenient for many who desire to cipally at le nks before the opening of navigation and is traveled ian and ly during the winter season. Supplies shipped in the spring banks by way of Dawson reach their destination earlier in the on than if shipped by way of St. Michael, as the upper Yukon is rst open to navigation. Freight rates on supplies shipped from Seattle to Fairbanks vary greatly according to their position in the freight classifications and according as they are sent by way of Dawson or St. Michael. During 1905 the rates ranged from $55 to $75 per ton on ordinary supplies. First-class passenger rates have ranged from $125 to $150.

The town of Fairbanks is situated on a slough of the Tanana, near the head of easy navigation, and in 1905 had a population of about 2,500. During dry seasons the quantity of water in the slough is so small that some of the steamers have difficulty in reaching the town. The larger boats that ply occasionally on the Tanana are unable to reach Fairbanks except at high water, and their supplies are left at Chena. Wages for miners are generally $5 and board, in some cases $6 and board, per day.

Fairbanks has newspapers, a school system, and three banks—one of them a national bank with currency of its own in circulation—and is the seat of the court which has jurisdiction over the whole of the interior of Alaska.

The town of Chena is situated about 9 miles from Fairbanks, at the entrance of the slough into the main river. It is accessible for the largest boats, but has the disadvantage of being several miles farther from most of the gold-producing creeks, and thus far its development has not kept pace with that of Fairbanks. The construction of the railroad has, however, favorably affected the growth of the town.

The transportation of supplies from the towns to the creeks has been a source of much trouble and expense, but cheaper and better transportation has been gained by constructing a narrow-gage railroad between Fairbanks and Chena, by extending a branch road from an intermediate point up the valley of Goldstream Creek to the junction of Pedro and Gilmore creeks, and also (1907) up Fox Gulch and along the divide between Vault and Dome creeks to claim 15 below on Cleary Creek, and by constructing Government wagon roads from the main supply points and from the terminus of the railroad *to the various creeks.*

The region, though dependent on the outside for the greatest part of its supplies, is in the matter of lumber and fuel mostly independent. The spruce timber along the sloughs of the Tanana and the lower parts of the valleys of its largest tributaries is of good quality and much of it exceeds 2 feet in diameter at the butt. The small spruce and birch, so abundant on the hillsides, furnish a supply of fuel which has not up to the present time been heavily taxed, but which is becoming year by year a more important item in the cost of production.

BED ROCK.

The bed rock is predominantly schist, closely folded and striking in general northeast and southwest. The main structural planes vary from nearly horizontal to nearly vertical. The alternating beds of blocky quartzite schist and schists with a large proportion of mica. give rise to a bed-rock surface of varying influence on the distribution of the gold. The gold sinks along the structural planes of the blocky bed rock to a depth of several feet in some places, but the compact clayey surface of the softer beds is practically impermeable to the gold. Quartz veins, some of them being 2 feet or more thick, are common in the schists, but are not so abundant that quartz becomes a conspicuous constituent of the gravels.

Granitic intrusions are present at several localities in the main ridge. They form the bed rock at the upper ends of some of the valleys and have furnished material for a small proportion of the gravels in many of the valleys. Greenstone schist forms a large part of the ridge west of Cleary Creek, and this rock is generally conspicuous by the quantity of garnets it contains. A small amount of black basaltic rock outcrops at the point of the ridge that forms the northern limit of the valley of Fairbanks Creek.

ALLUVIAL DEPOSITS.

The loose material formed by the weathering of the bed rock varies in character according to the amount of transportation it has undergone. Outcrops of bed rock in the Fairbanks region are confined mostly to the summits of the ridges and to the steeper slopes of the valleys, while on the gentler slopes and in the bottoms of the valleys the bed-rock surface is covered with a mantle of material ranging in thickness from a few feet to over 300 feet. This mantle is composed partly of heterogeneous talus, which is continually working down the sides of the valleys, and partly of the material in the valley floors, which has been worked over so many times by running water that it has a fairly uniform structure throughout. All of these deposits are, for the most part, frozen throughout the year.

As the streams generally flow close to one side of their valleys the deposits are mostly on but one side. Their upper surface slopes grad-

ually toward the base of the hills. The bed-rock surface, so far as known (1905), is in general nearly flat, or has a very gentle grade hillward from the creek. The deposits are in most places separable into three divisions, which, from surface to bed rock, are referred to by the miners as muck, barren gravels, and pay gravel.

The muck ranges in thickness from a few feet to a maximum of about 70 feet, the line of separation between it and the underlying gravels being fairly sharp. It is a black deposit containing a large amount of material derived from the decomposition of moss and other vegetation, a considerable percentage of clay and sand being either intermingled with the organic matter or distributed as layers and thin lenses irregularly through the mass. Horizontal, and occasionally vertical, sheets of ice several feet thick occur in this deposit.

The underlying gravels, ranging in thickness from 10 to over 60 feet, are derived from the rock occurring within the areas drained by each particular stream. As quartzite schist is the most common bed rock and also the most resistant to the processes of wearing and weathering, the largest proportion of the coarse material in the gravels is composed of it. The gravels also include quartz-mica and carbonaceous schist, vein quartz, and some igneous material, mostly granite. Teeth of the mammoth and bones of other animals now extinct are occasionally found. The coarse material being mostly schistose occurs as more or less flattened angular pieces, only slightly waterworn. Few of them exceed a foot in diameter and the proportion of bowlders is therefore small. The fine material is composed partly of smaller pieces of the more resistant rocks and partly of clay derived from the decomposition of the micaceous and carbonaceous schists. These gravels contain also a small percentage of individual minerals released by the process of weathering. The proportion of clay in the barren gravels is small, but that in the underlying pay gravels is large. All the material, both coarse and fine, is irregularly intermingled, the larger pieces being usually nearly horizontal.

The pay gravels resemble those above them, but contain a considerable amount of clay, which adheres tightly to the gravel and to the surface of the blocky fragments of bed rock. This clay is prevailingly of a yellowish color in the more shallow diggings and of a bluish color in the deeper gravels. The proportion of clay varies, but in most places there is enough present to render the pay gravels easily distinguishable in the drifts from the barren ground above them. The thickness of the pay gravels ranges from a few inches to 12 or more feet, a range which is rather uniformly maintained. The under surface of the gravels not only rests upon the bed rock, but where the latter is blocky the fine material is found within it to a depth of from 1 to 3 or more feet. The pay gravels vary in width

in different creeks and in different parts of the same creek, but make up only a small part of the width of most of the valleys. Pay streaks ranging in width from 30 feet or less to 450 feet, and in one place reaching a width of 800 feet, have been reported. The average width of gravels carrying values sufficient to pay for working under conditions in 1905 is probably about 150 to 200 feet, and this, like the thickness, is fairly constant. The pay streaks in the valley floors bear no uniform relation to the present stream beds.

The gold is either evenly distributed throughout the pay gravels or lies mostly near the bed rock, or, occasionally, is found chiefly within the bed rock. The great bulk of the gold is composed of flattish pieces of various sizes up to one-fourth inch in diameter and of granular pieces, some of which are minute. The proportion of very fine gold, however, is apparently small, and there is but little flaky gold. Nuggets form an inconsiderable part of the clean ups; those worth a few dollars are common, however, and a few of considerable value have been found. Some of the largest were worth approximately $145, $160, $190, $233, and $529. Many of the nuggets contain quartz. Most of the gold found near the heads of the creeks is angular. Downstream there is in general a gradual decrease in the average size of the pieces and an increase in the amount of wear they have sustained. Nuggets, too, are less common in the lower parts of the valleys. In some places coarse and fine gold occur together; in others the coarse gold is found mostly on one side of the pay streak. At a few localities there appears to be an abrupt change from gravels carrying a large percentage of coarse gold to others—immediately below on the same stream—whose gold content is chiefly fine. The values in the pay gravels exploited in 1905 range from about 2 cents to 20 cents or more to the pan, and a large part of the ground will average about 8 cents to the pan, or about $10 to the cubic yard or $2 to the square foot of bed rock. Some of this ground averages $3 to $3.50 to the square foot and some carries even better values. Assay values were reported ranging from $16.16 to $18.25 of gold per ounce, and the gold from one locality was said to assay as high as $19.25.

The minerals most commonly associated with the gold, aside from the quartz with which it is often intergrown, are garnet, rutile, and black sand. The black sand occurs in but small proportion and is composed mostly of magnetite. Cassiterite is rather common, and there is some stibnite. Bismuth is occasionally intergrown with the gold.

The frozen gravels are tough, in distinction from the muck. They can not be broken with the pick and are with difficulty rent by explosives. A sudden caving in of the ground undermined in drifting

is rare, the sinking usually being so gradual as to permit the removal of mining apparatus. In such cases a parting often takes place between the gravels and the overlying muck leaving the latter as a roof. The solidly frozen gravels are practically impermeable to the surface waters and to any underground water that may be present and the underground mining operations are comparatively dry. Unfrozen areas are encountered at many places, and where they occur in the deeper ground the presence of "live water" adds to the expense of mining. In other places, notably near the heads of some creeks where the gravels are shallow, unblanketed by muck, and well drained, the greater part of the ground thaws during the summer.

Bench gravels are not common in the Fairbanks region. A deposit of gravels composed essentially of quartz-mica schist, carbonaceous schist, and vein quartz has, however, been found on the northern valley slope of Fairbanks Creek, 600 feet above the valley floor. The gravel is rather well rounded and contains bowlders up to 1 foot in diameter. These gravels have been somewhat prospected, but so far as known, without favorable results.

FORMATION OF PLACERS.

It appears from a cursory examination that the pay gravels were deposited under conditions somewhat different from those which now prevail. Though the details can not be discussed here, some of the facts bearing on this matter deserve mention. The general uniformity in the altitude of the ridges has been noted. This uniformity is the result of the erosion of a surface which formerly stood at a lower level than at present. Its topography was then undulating, dotted with rounded hills, and broken by isolated groups of hills and ridges of greater prominence. The valleys, furthermore, were open and of low grade. It is probable that the stream deposits were deep and that the interstream areas bore much weathered bed rock, awaiting transportation. Elevation of the region enabled the streams to cut the present valleys and thus form the avenues, or sluice boxes as they might be called, through which passed the products of long-continued weathering as well as the deposits of the former streams. The bench deposits above described form a remnant of these old deposits.

In the constant, slow, and often interrupted progress of the unsorted coarse and fine material down the valleys the particles of gold, because of their high specific weight, tend to lag behind the particles of other materials and to find a lower position in the mass or a lodgment in the crevices of the bed rock. They offer a passive resistance to onward motion and an active assistance to vertical downward motion. The accumulating deposit of gold is mixed with unsorted material *which, for* the most part, was probably not originally associated with

the gold but was derived from some source farther up the valley. This deposit closely follows the cutting action of the stream and is the first to cover the bare surface of the bed rock when opportunity is offered.

Active erosion and an abundance of previously accumulated auriferous material appear to be favorable to the formation of placers. The so-called "wandering" placers which have been noted in Australia,[a] where the pay dirt is shifted at times of melting snows to claims lower down the valley, appear to represent an early stage in the development of placers. With the lessening of the stream's activity, accompanied often by the exhaustion of the great part of the auriferous material, the mobility of the deposits is diminished. An increasing amount of barren material is then deposited over the pay gravels, the stream may abandon the part of the valley in which it has hitherto worked and the pay streak may become practically a stationary deposit. In the interior of Alaska the pay streak has become not only permanently stationary, but also, through the cementing agency of ice, for the most part permanently consolidated.

Few facts are known regarding the amount, distribution, or circulation of the underground waters and the consequent extent of the permanently or only temporarily unconsolidated gravels. In the Yukon-Tanana country there are valleys whose deposits are so "spotted," as it were, with live water that it is practically impossible to work them by drifting. The presence of large amounts of live water in many valleys during the winter is shown by the repeated overflows to which streams are subject and by the unexpected filling of prospect holes with water from below. It is possible, therefore, that the extent of the unfrozen ground is greater than is generally supposed. The extent of consolidation, while dependent primarily on the climate, is probably greatly modified by local conditions. The slope of the valley, the character and thickness of the deposits, and the quantity of water are factors which together may become of dominating importance, counteracting successfully the tendency of the climatic conditions to cause consolidation of deposits to great depths. As a result, a part of the deposits of a valley, whether talus or stream gravels, where not too deep, may be further differentiated. This differentiation, under the mobility imparted by the contained water and by the stream action to which they may be subjected, may bring about the gradual accumulation of the gold on or near the bed rock. In the Fairbanks region this process would be most active in the shallow deposits which are generally confined to the headwaters of the valleys. Although the quantity of weathered material now at hand is not so large as formerly, when the product of long-continued weathering had accumulated, and although the proportion

[a] Schmeisser, Karl, Die Goldfelder Australiens, p. 100.

of gold may now be different from what it was formerly, nevertheless it is reasonable to suppose—and the occurrence of gold near the headwaters renders such a supposition entirely justifiable—that the deposition of auriferous material is there in progress. At present the streams come in closest relation in the vertical section to the bed rock near the heads of the valleys, and there, if anywhere within the valleys, downward cutting of the bed rock is in progress. The lower parts of the valleys have been areas of abundant deposition. Near the heads deposition closely follows cutting and there the deeply buried, more or less permanently frozen pay streaks of the lower valleys merge into the deposits within the zone of the present streams' activity.

The gravels in the valleys of the Fairbanks region are composed of materials derived from the bed rock in which the valleys have been cut and were deposited through stream action, uninfluenced by any general glaciation, yet under conditions somewhat different from those of the present. The position of the pay streak in the valley marks the position of an earlier drainage way as well as that part of the cross section of the valley which was at the time of its deposition probably the deepest.

The successive stages of development may have been somewhat as follows: (1) Elevation of the region, the surface being laden with much unassorted weathered material and older stream deposits; (2) a period of active erosion by the streams during which there was little opportunity for the formation of permanent deposits; (3) a period of deposition when the streams were nearly down to grade and when the pay streaks were, for the most part, laid down with their clay content, which may have been derived in part from the abundant clay of the weathered material and in part directly from the bed rock; and (4) a period of stream shifting, valley widening, and further deposition, with the gradual development of the unsymmetrical type of valley of the present day. This unsymmetrical shape—one side steep and the other a more or less gradual slope—is a characteristic feature of many valleys in Alaska and results probably from several causes, among which are local elevation or depression, lithologic character and structure, and insolation. It suffices here to emphasize only one of these, often observed by miners—that the sunny side of valleys is subject to more rapid wear than the shady side, which remains locked in frost for a much greater part of the open season. Slides are of frequent occurrence on the sunny sides of the valleys, even on very gentle slopes, and in the course of time these produce an accumulation of waste which forces the stream toward the opposite slope of the valley.

The greater mobility of the material was due probably in part *to the greater* activity of the streams, which were at that time just

becoming graded; in part to more abundant precipitation, as is suggested by the much greater extension of the glaciers of the Alaska Range, and in part, perhaps, to a higher average temperature, though it would seem that with the other factors present no essential difference in the temperature would be required. Whatever the conditions of formation—and these are only imperfectly known—the dominant facts of economic importance are that in general but one pay streak has been laid down; that this is next to bed rock beneath a considerable thickness of other deposits, and that its formation is, for the most part, a closed incident.

SOURCE OF THE GOLD.

The origin of the gold in the placers, although not definitely determined, is suggested by the character of the gold itself and by its association. Most of that found near the heads of the creeks is rough and practically unworn; much of it is flat, as if derived from small seams; most of the coarse pieces are intimately intergrown with quartz and many of them are flat, like the small fragments of thin quartz seams which are common in the schists. That mineralization has not been confined to gold is shown by the occurrence of native bismuth intergrown with gold, of veins of stibnite, and of the cassiterite often found in the gravels. The most acidic igneous rocks observed in the Fairbanks region are intrusive porphyritic biotite granite. The acidic dikes so common in the Fortymile region are absent and the gold of the placers has probably been derived from small quartz seams in the schists.

It is often a subject of surprise to the miners that when gold is abundant in the placers it should be found so rarely in the bed rock. It might be said that if gold were commonly encountered in the bed rock the proportion of it in the placers, considering the amount of bed rock that has been removed, ought to be much greater. There is the possibility also that the veins in the country rock which contributed the material for the first deposits of the valleys were richer in gold than those now exposed. Be that as it may, it is certain that through long-continued weathering and sorting of the rock material a concentration of the heavier indestructible contents, including the gold, takes place, yielding auriferous detrital deposits which are made richer in gold than the parent rock. Furthermore, much of the gold may have been contributed by the bed rock that has been removed in the formation of the present valleys.

PLACERS.

The productive areas of the Fairbanks region at present (1907) include the valleys of streams draining the ridge that extends northeast and southwest between Chatanika and Little Chena rivers. The distance between these two streams is about 25 miles and the gold-

bearing creeks are located at intervals along a distance of about 30 miles.

FAIRBANKS CREEK.

Fairbanks Creek is about 10 miles long and flows in an easterly direction to Fish Creek, a tributary of Little Chena River. The floor of the valley is 200 to 450 feet broad but widens rapidly about 3 miles from the mouth. The productive area of Fairbanks Creek comprises about 4 miles of the valley, starting from a point about 2 miles below the source. The gravels in general range from 12 to over 30 feet in thickness but in the lower part of the valley are much thicker. The pay streak ranges from 4 to 8 feet in thickness, averaging about 5½ feet, while in some places 2 to 3 feet additional of bed rock are mined. The pay streak ranges from 40 to 200 feet in width and in the upper part of the valley lies close to the present stream bed but lower down the valley it diverges toward the north valley slope. Ground has been worked containing values in the pay streak ranging from 5 to 10 cents to the pan. As this streak has not been traced through the lower part of the valley it is uncertain whether it continues as a well-defined pay streak or becomes disseminated or distributed over a considerable area. Fairbanks Creek has been a good producer but is somewhat spotted, and ground should be carefully prospected to determine values before the introduction of expensive machinery. The following table of depths to bed rock, etc., is based on data obtained by Mr. Covert in 1907.

Depth to bed rock, thickness of muck, and width of valley floor along Fairbanks Creek.

Claim No.	Depth to bed rock.	Thickness of muck.	Width of valley floor.
	Feet.	*Feet.*	*Feet.*
8 above	14	4	250
7 above	13	6	250
6 above	16	8	300
5 above	30	20	300
4 above	30	20	300
3 above	26	6	400
2 above	25	5	400
1 above	16	7	400
Discovery	17	5	400
1 below	19	5	450
2 below	18	6	450
3 below	23	6	450
4 below	23	6	450
5 below	16	4	400
6 below	26	8	450
7 below	32	11	450
10 below			

GOLDSTREAM BASIN.[a]

Goldstream Creek is 50 or 60 miles in length and the upper 7 miles of it have been found to be auriferous. The floor of the auriferous

[a] The information regarding the Goldstream basin was obtained during the field season of 1907 by Alfred H. Brooks and C. C. Covert.

part of the valley is from one-half to three-fourths of a mile in width and from this floor the walls rise with gentle slopes. Gold has been found on Pedro and Gilmore, Engineer, Big Eldorado, and O'Connor creeks and on Fox Gulch, all tributary to Goldstream Creek. The bed rock throughout most of the basin is probably mica schist, but granite has been found on several of the tributaries, notably on Pedro and Gilmore creeks. Pedro Creek was the scene of the first discovery of gold (1902) and this creek and the main stream have been large producers in the last two years. The alluvium of the basin ranges in depth from a few feet in the headwater region to more than 200 feet near the lower limit of discovery on Goldstream Creek. The gravels consist predominantly of mica schist, with considerable quartz and some granite.

Most of the work on Goldstream Creek during 1907 was confined to the portion of the valley from Discovery claim, near the confluence of Pedro and Gilmore creeks, to about 17 below Discovery. The pay streak from Discovery to about 7 below lies on the north side of the creek; below this point it is on the south side. The limit of profitable mining, as determined by present methods and costs, is probably $1.50 to $2 a cubic yard. If a cheaper method of handling the gravels could be devised it would make available for mining an enormous body of gravel. The following table shows the thickness of the deposits in the upper part of the valley so far as known.

Depth of bed rock, thickness of muck, and width of valley floor along Goldstream Creek.

Claim No.	Depth to bed rock.	Thickness of muck.	Width of valley floor.
	Feet.	*Feet.*	*Feet.*
Discovery to 8 below	15-20		1,000
8 below	22	9	
9 below	25	12	
10 below	20		1,500
12 below	45-60	30	2,500
14 below	70		3,000
15 below	110		3,000
16 below	80		3,000
17 below	65		3,000
27 below	60		3,500
29 below		90	
32 below	160	130	2,500
37 below	158	150	

The Pedro Valley is similar in general character to the Fairbanks Valley, already described. The productive area includes about 2 miles of the stream between the mouth of Twin Creek and the point where it is joined by Gilmore Creek. The deposits have a thickness ranging from about 8 to 30 feet. Values have been found in some places through 8 feet of gravel and 4 feet of bed rock; in other places they are confined mostly to the bed rock.

Gilmore Creek, which joins Pedro to form Goldstream, flows in a general northwesterly course and has a length of about 5 miles. The

valley floor at its mouth is about 1,000 feet wide, narrowing rapidly upstream. The bed rock of the main creek is chiefly quartz-mica schist, much of it carbonaceous, but a granite mass is found to the south and also in the valley of Hill Creek, a small tributary. The alluvium, which is 50 to 60 feet deep near the mouth of Gilmore Creek, shoals rapidly upstream and 2 miles above is only about 10 feet deep. Most of this is muck, which ranges from 45 feet near the mouth of the stream to less than 5 feet 2 miles above. The gravels are chiefly schist of several varieties, with considerable quartz, which occurs to some extent in large bowlders, and much granite. An important commercial feature of the creek is the presence of an ill-defined bench on the north slope of the valley. This is in some places separated from the main valley floor by a rock rim with an escarpment of a few feet, but usually slopes directly to it. The bench gravels are auriferous and have been mined at three localities. Much of the material is angular and ill stratified and in many places it resembles a talus slope rather than a water-laid deposit. These bench placers are favorably located for economic mining and have yielded some gold but in dry times there is not sufficient water for hydraulicking. The pay streak in the Gilmore Creek gravels is said to be 30 to 40 feet wide but in places attains a width of 100 feet. On the hill-slope terraces it appears to embrace the entire bench, from 100 to 300 feet wide. The placer gravel of this creek is usually found down to or in the bed rock. In places 3 to 4 feet of the bed rock is mined, with but a foot or two of the overlying gravels. The gold ranges from medium coarse to fine and that of the benches appears to be more angular than that of the creek. Nuggets up to a value of $20 are reported. The gold is said to assay $19.25 to the ounce. Some bismuth has been found with it.

Tom Creek, a tributary to Gilmore Creek 3 miles from the mouth, lies in the extension of the main valley. No values have thus far been reported on it. Hill Creek, a southerly tributary of Gilmore Creek, has its source well back in a high granite dome and the bed rock for much of its length appears to be granite. Near its head is a small basin 200 or 300 yards long. Below this basin the valley floor falls away with steep descent for about a quarter of a mile. The bed rock is a coarse porphyritic biotite granite, which in the basin is deeply weathered and stained with iron. Here some open-cut mining has been done. No one was at this place when visited by the geologists but the pay streak appears to be very narrow. The alluvium consists of granitic sand about 8 feet deep. This occurrence is of interest because it shows that the gold has been derived from the granite. This deposit is near the contact with the schists and indicates that the granite intrusives may bear a genetic relation to the occurrence of the gold in bed rock.

Fox Gulch is a small northerly tributary of Goldstream Creek. Little mining has been done on the lower part of the creek where the alluvium is probably 30 to 40 feet deep. Several claims have been worked about 3 or 4 miles from the mouth, at a point where the gravels are 8 to 10 feet deep, overlain by muck about 10 feet thick. The pay streak here is rather narrow and the reported values are not high.

Some gold has been found on Big Eldorado and O'Connor creeks but as neither has been visited by a geologist details regarding them are lacking. Both these creeks are tributary to Goldstream from the north, and each is about 5 miles in length. The pay streak on Big Eldorado Creek is said to be narrow, but some mining has been done. Work on O'Connor Creek is said not to have gone beyond the prospecting stage (1907). Ground is reported to be from 100 to 130 feet deep.

Engineer Creek, about 5 miles in length, a southerly tributary of Goldstream, has also become a producing creek during the last two years. The placers of this stream have not been studied by any geologist.

The gravels on some other small tributaries of Goldstream Creek have been found to be auriferous, but no values have been discovered. This does not signify, however, that they are not worthy of careful prospecting.

CLEARY CREEK.

Cleary Creek has been the best producer of the region. Workable deposits have been found along about 7 miles of the stream and far out into the Chatanika flats. The limit of their extension into the flats has not been determined. Chatham Creek, only about a mile long, has been a good producer. Considerable work was done on Wolf Creek in 1903, but since that time little gold has been found there.

The deposits of the main valley range in thickness from a few feet to more than 120 feet, averaging about 60 feet. The pay streak has a maximum thickness of about 14 feet and an average for the creek of about 5 feet. The width of the pay streak, under present mining costs, ranges from 30 feet or less to several hundred feet. The average value in the pay streak for much of the valley appears to be about $10 to the cubic yard. The pay streak is rather uniformly developed, but the valley is so wide that its location requires much prospecting. The position of the pay streak in the valley is at variance with the course of the present stream. The creek makes one large bend in its course, above which the pay streak is altogether on the west side, several hundred feet from the creek, except at the head. It crosses the valley at the bend, and throughout the lower part is found on the

right side, 1,000 feet from the stream. As the valley of Cleary Creek opens into the Chatanika flats the pay streak swerves back to the left side and has been found there within a short distance of the creek. The pay streak occupies, in general, the center of the valley, being about equidistant, both above and below the bend, from the ridges on the sides. Gold was discovered at the point where the pay streak crosses the valley, where good surface prospects were found. The following table of depths to bed rock, etc., is based on data obtained by Mr. Covert in 1907:

Depth to bed rock, thickness of muck, and width of valley floor along Cleary Creek.

Claim No.	Depth to bed rock.	Thickness of muck.	Width of valley floor.
	Feet.	*Feet.*	*Feet.*
8 to 1 above	40–50		300–500
Discovery	14–20		800
2 below	40		500–600
6 below	90		800
7 below	25–27	7	800
10 below	80		800
13 below	110–120	40	1,000
15 below	100 (left limit) 60 (creek claim) 90 (first tier, right limit)		1,000

The important characteristics of the Cleary deposits are their thickness, the only shallow diggings being on Chatham and Wolf creeks and at the very head of Cleary Creek, the relation of the pay streak to the present course of the creek, and the extension of the pay throughout the lower part of the valley.

ELDORADO CREEK.[a]

Eldorado Creek is a southerly tributary of the Chatanika, its valley lying between that of Cleary Creek on the northeast and Dome Creek on the southwest. Its length is about 4½ miles, and the valley floor is from 100 yards to half a mile in width. The bed rock of the basin is, so far as determined, a quartz-mica schist, and the presence of diorite bowlders in the gravels indicates the presence of intrusives in the basin. The creek falls about 150 feet to the mile, but the slope of the bed-rock floor has not been determined. It appears, however, to be somewhat irregular.

Depths to bed rock range from 60 to 120 feet in the lower half of the creek, which is the only part visited by the writer. The muck is 20 to 40 feet thick. The gravels are well rounded and are made up largely of mica schist, with some dioritic rock and some large bowlders of white quartz. The alluvium appears to be generally frozen.

[a] These notes are based on a hurried examination made by Alfred H. Brooks in 1906.

Though staked some years before, the first systematic prospecting was done in 1906 and met with only moderate success. The gravels were found to be auriferous, but no pay streak had been discovered at the time of the writer's visit. It is reported that in 1907 values were found on one claim and some gold taken out.

The valley of Eldorado Creek, lying as it does between two of the important gold producers, certainly deserves careful prospecting. There appears to be good reason to believe that it will yet become a producer.

DOME CREEK.[a]

Dome Creek, also a tributary of the Chatanika, heads in the west side of Pedro Dome. The bed rock and gravels are similar to those of Cleary Creek. The depth to bed rock where the ground is being worked ranges from 30 to 200 feet. The slope of the bed rock in the lower part of the valley is about 15 feet to the mile. The surface of the bed rock is uneven, variations of 15 to 20 feet being common. The pay streak has been found to be from 130 to 165 feet wide. The material includes 2 to 3 feet of bed rock and 2 to 3 feet of gravel. Good reports were coming from nearly the entire length of the creek in September, 1907.

VAULT CREEK.[b]

Vault Creek, about 6 miles in length, flows northward into the Chatanika, and is adjacent on the west to Dome Creek. Bed rock is probably schist throughout the basin, but there are no exposures except on the round ridges.

The east wall of the valley rises by a gentle slope; the west wall is more abrupt. This gentle slope appears to be underlain by a heavy deposit of muck having a maximum thickness between 50 and 75 feet and thinning out toward the creek as well as toward the ridge. Below this muck there is a deposit of sand and fine gravel with some clay—30 to 60 feet thick—overlying coarse gravel which is auriferous. The depth to bed rock varies greatly, being determined by the position of the shaft, whether on the creek bed, where the alluvium is said to be not more than 50 feet deep, or on the talus slope, where it may be 200 feet.

The pay streak is reported to be 100 feet or more wide, with a thickness of 3 to 6 feet. It has been rather definitely traced for a couple of miles along Vault Creek below the mouth of Treasure Creek, and for half a mile up the latter stream. Little prospecting has been done on the lower part of Vault Creek, where the alluvium is said to be very deep. Near its mouth, in the Chatanika flats, the

[a] By Alfred H. Brooks and C. C. Covert.

[b] The information on Vault Creek was obtained by Alfred H. Brooks in 1907.

alluvium is 319 feet deep, of which 60 feet is muck. The pay streak was struck at 160 feet, on a false bed rock. Prospecting has been done on Vault Creek for several years, but it was not until 1906–7 that good values were found. In 1907 there was a considerable production. The creek has been rendered easily accessible since the railway was extended down the side of its valley in 1907.

OUR CREEK.[a]

Our Creek is tributary to the Chatanika west of Vault Creek. It has a length of about 7 miles and a general northerly course. This creek has not been visited by a geologist, but it is reported to be very similar to Vault. In 1907 good prospects were reported to have been found. If values are obtained in this basin it will show that the gold-bearing area extends to the west.

ESTHER AND CRIPPLE CREEKS.[a]

Esther Creek adjoins Alder Creek to form Cripple Creek, which is tributary to Chena Slough. The lower part of Cripple Creek flows through a broad flat, but about a mile from the slough the valley becomes well defined. Its floor here is about half a mile wide and is bounded by ridges 500 to 1,000 feet high. The Esther and Alder creek valleys are about one-half mile wide at their mouths and gradually narrow upstream. So far as known the bed rock of the entire basin is principally mica schist, but some granite is known to occur on Esther Creek.

Esther Creek has a length of about 5 miles, and gold has been found about 4 miles from the mouth. The depth to bed rock ranges from between 120 and 135 feet near the mouth to 15 feet 4 miles above. The following table shows some of the important features of the alluvial deposits.

Depth to bed rock, thickness of muck, and width of valley floor along Esther Creek.

Claim No.	Depth to bed rock.	Thickness of muck.	Width of valley floor.
	Feet.	*Feet.*	*Feet.*
7 and 8 below	90	40-60	1,000
2 to 4 below	65-75	25-30	----------
1 below	60	20	700
Discovery	55	15	----------
3 to 5 above	25	9-12	----------
7 above	15	3±	200

The above depths to bed rock are only approximate, as they vary greatly in any given cross section of the valley. For example, on

[a] Based on information obtained by Alfred H. Brooks in 1907.

claim No. 4 the depth to bed rock near the east side of the valley was found to be nearly 100 feet, while on the claim above, a hole on the west side of the valley encountered bed rock at 40 feet. The matter is further complicated by a terrace (20 to 40 feet) of fine silt, with a little sand and gravel, remnants of which are preserved at various places along both slopes of the valley. The bed rock underneath this terrace appears to lie at about the same altitude as that under the creek bed, but holes sunk through the terrace to bed rock are necessarily much deeper than those in the valley floor. A still higher terrace has been found along the east side of the valley near a tributary called Ready Bullion Creek. Here a heavy deposit of silt 40 to 60 feet deep was found resting on some well-washed gravels which overlie a bed-rock floor standing 100 to 200 feet above that of the creek bed. These high gravels are known to carry colors and are worthy of further investigation. The gravels are iron stained, like those of the bench placers on Cripple Creek.

The gravels of Esther Creek are in the main well rounded and are made up principally of mica and quartz-mica schist. Some large bowlders of quartz, the larger of which reach 2 feet in diameter, are also present. Granite pebbles are not uncommon, and in some places, notably on No. 4 below, they form a large percentage of the gravels. The bed rock, as stated, is generally a schist, though in some places granite has been found. The schist ranges from a fine-grained mica variety, which is as a rule deeply weathered, to a harder quartzose phase which approaches a quartzite and is commonly blocky. The ground is usually frozen, but one belt of thawed ground has been found. The pay streak as mined averages between 5 and 6 feet, of which from half to two-thirds is gravel and the balance weathered bed rock. The width of the pay streak, as defined by the present cost of mining, is about 40 to 50 feet for the upper part of the creek. The values in the material hoisted probably average $4 to $6 to the cubic yard.

Esther Creek was first staked in 1903, and some careful prospecting was done on it during the following year, but its output did not become important until 1906. It now has an established position as a large gold producer, and there is much ground on the creek which has not been prospected.

In 1907 several mines were in operation on the east side of Cripple Creek and are reported to be working on bench gravels, but these deposits have not been studied. These gravels are red like the bench gravels on Esther Creek. Some gold has been taken out, but little mining except this has been done on Cripple Creek.

Alder Creek has yielded no gold, though the gravels are said to be auriferous, and it appears probable that this creek also lies in the

gold belt. Some extensive prospecting was done on this stream with a churn drill during the winter of 1907 but the results are not available for publication.

All these creeks are readily accessible from the Tanana Valley Railway. A good road leads up Esther Creek and several feeders have been built.

SMALLWOOD CREEK.[a]

Smallwood Creek, a westerly tributary of the Little Chena, is about 9 miles in length. The floor of its valley where work is in progress is about half a mile wide, and from this floor the valley walls rise with gentle slope to the bounding ridges, which stand at 1,000 to 1,600 feet above the sea. Smallwood Creek has not been gaged, but appears to carry a large amount of water. The gradient of the creek is low, probably not over 60 feet to the mile in the upper half of its course and somewhat less in the lower half. There is little clue to the character of the bed rock except the constitution of the gravels. It is known, however, that the ridge lying northwest of Smallwood Creek is made up largely of granite and that granite forms the bed rock of much of Nugget Creek, a westerly tributary of Smallwood. To judge from the alluvium, mica schist is probably the country rock of much the larger part of this basin. Among other rocks noted in the gravels is a fine-grained rock carrying porphyritic crystals of feldspar.

Comparatively little prospecting has been done on Smallwood Creek, and it is therefore possible to make but few statements as regards the character and depth of the alluvium. It appears that the bed-rock floor has in general about the same slope as the present stream valley, but locally some irregularities occur. The depths to bed rock as reported by miners are as follows:

Depth to bed rock and condition of ground along Smallwood Creek.

Claim number.	Depth to bed rock.	Condition of ground.
	Feet.	
1 above (mouth of Nugget Creek)	50	10 feet of muck; ground thawed.
2 above	50	Ground frozen.
3 below	108	Do.
4 below	130	25 feet of muck; ground frozen.
5 below	135	Ground frozen.
7 below	145	45 feet of muck; ground frozen.
17 below	317	60-100 (?) feet of muck; ground frozen.

This table indicates that there is a body of gravel ranging in thickness from 40 feet near the head of the creek to 200 feet 5 miles below. As the creek valley is from 100 yards to half a mile or more

[a] This description, by Alfred H. Brooks, is based on one day's examination of the upper part of the creek and on compiled information.

in width, it is evident that there is here an enormous body of gravel. The overburden, usually termed muck by the miners, is a fine silt or clay, in general of a dark-gray color. This overlies sands and gravels which appear to increase in coarseness toward bed rock. The gravels are mostly well rounded except on bed rock, where they are angular. They are made up in the main of mica schist, with much vein quartz, and also carry granite, which at the mouth of Nugget Creek predominates over the other material. The pebbles of gray porphyritic rock have already been referred to.

Claims were first staked on Smallwood Creek in November, 1904, but no considerable work appears to have been done until 1906. During 1906 and 1907 probably a dozen claims were worked. This prospecting has been sufficient to establish the fact that the gravels of at least the upper 2 miles of Smallwood Creek and some of its tributaries are auriferous, and at some localities values have been found. Perhaps the most significant feature is the reported finding of good prospects at No. 17 below, at a depth of 317 feet. The writer was unable to visit this locality, but it appears that the discovery is sufficiently encouraging to warrant further developments. If values have been found in this lower part of the creek, as they are known to occur in the upper part, it augurs well for the occurrence of gold between.

So little ground has been opened up that it is impossible to make any generalizations as to the width of the pay streak. It is reported that on one claim values have been found for a width of 120 feet, and that these occur in the lower 3 to 4 feet of gravels and in the decomposed bed rock to a depth of 2 to 2½ feet.

The gold seen by the writer is medium fine and occurs in small scales. Nuggets are relatively rare, the two largest reported being valued at $2.75 and $11.50. The gold is said to run about $18.11 to the ounce.

The ground in the upper mile of the creek is said to be thawed and is shallow enough to be worked by dredges or open-cut methods.

The meager information here set forth clearly indicates that this creek and its tributaries are well worth careful prospecting. The lower valley is so wide that it will be expensive to prospect it carefully, and it would appear that this can best be done by grouping the claims and systematically crosscutting the entire body of gravel.

MINING METHODS.

The methods of mining in the Fairbanks region (1905) are the same as those used extensively for similar types of deposits in the Klondike region. The methods have been necessarily determined by the grade of the valleys, the thickness and character of the de-

posits, and the available water supply. Only a small part of the ground has a grade of over 100 feet to the mile and most of it has considerably less. The deposits worked range from a few feet to over 120 feet in thickness. The creeks are small, carrying ordinarily 200 to 400 miner's inches of water. In dry seasons the present sources of water supply would be inadequate, and, while thus far only short ditches have been in use, a project is under way to supply some of the areas with water from the upper part of Chatanika Valley by means of a ditch about 75 miles long.

PROSPECTING.

As the pay streak, if present, lies almost everywhere on bed rock, the chief work of prospecting consists of sinking holes to bed rock. It is usually necessary to thaw the ground, and while crude methods requiring wood fires or hot water are still in use, the most approved method, and the one most commonly employed, is that carried on by means of steam. Small, portable, knockdown steam-thawing outfits that can be packed on horses are now obtainable, thus permitting prospecting in remote areas. After the ice has been melted the material to be excavated is loosened with a pick, shoveled into a bucket, and hoisted to the surface, usually by hand windlasses. If the ground is deep the prospect shaft is generally timbered to the depth of the overlying muck. The most formidable difficulty encountered in sinking is live water, which often necessitates the abandonment of shafts. Great depth of ground also increases the difficulty of sinking holes, and consequently makes the work of locating the pay streak slow.

OPEN-CUT MINING.

The ground is generally stripped first of all by sluicing off the overlying muck. A bed-rock drain is then constructed, and an open cut of sufficient width for one or two sets of boxes is carried gradually up the valley. In some cases the gravel is hoisted by steam power entirely out of the cut to boxes set above the surface and to one side of the workings. By this method a frequent resetting of the boxes is avoided and there is a better disposal of tailings. Gravel is hoisted by derrick, by automatic trolley, or by a rock pump. Where the last method is used a set of boxes is placed on the bottom of the cut, the coarsest pieces are forked out, and all the rest of the material is elevated through the pump to the boxes on the surface. Owing to the depth of the gravels the open-cut method and its modifications are of limited application.

DRIFTING.

The methods of working the deep gravels of this region are similar to those employed in the deep gravels of other fields, with the modifications rendered necessary by the frozen character of the

ground. These methods have gradually developed in the Yukon Territory and in Alaska, and from year to year have become more efficient in solving the problems that are met. In the Fairbanks region in 1903 thawing was accomplished by the cruder methods mentioned, and equipments for thawing by steam, which had been found so effective in the Klondike region, were not plentiful. Since then extensive steam plants have been introduced, capable of thawing and handling daily large quantities of gravel.

The process in general includes the following operations: (1) The sinking of a shaft to bed rock, ranging in depth from 20 to 300 or more feet; (2) the timbering of the shaft and the portion of the drifts near the shaft; (3) the opening up of the ground by drifts which are run either parallel to or across the pay streak and from which crosscuts are driven; (4) the extraction of the gravel from the crosscuts, beginning at the farther limits of the drifts and working toward the shaft; (5) the hoisting of the pay gravel with as little waste as possible to the surface; and (6) the recovery of the gold by ordinary sluicing. The main drift is usually carried to a maximum distance of about 200 feet in each direction from the shaft, and the ground is blocked off by crosscuts having a variable length up to about 100 feet. Fortunately but little timbering is generally required. Where the ground is weak, pillars are left at intervals of about 25 feet when working back the faces toward the shaft. Ordinarily, as mining commences at the extreme limit of the area to be worked, the ground from which the pay dirt has been removed is allowed to settle if it will. Experience has shown that settling is generally so gradual that the work can be carried away from the settling ground with sufficient speed to avoid trouble.

The steam-point method of thawing is the one most commonly in use. The steam point is a piece of one-half or three-eighths inch hydraulic pipe, 5 to 8 feet or more in length, with a blunt, hollow point of tool steel for piercing the ground and a solid head of tool steel or machine steel, sufficiently strong to withstand the impact of a maul or sledge. Steam is admitted through a pipe fitted laterally in a small aperture near the head. The points are placed about $2\frac{1}{2}$ feet apart, and from a dozen to twenty or more are used in a plant of average size. The power needed is 1 to 2 horsepower per point and the duty of a point is 3 to 4 or more cubic yards per day of ten hours. In use the point is driven in gradually as the ground becomes thawed. It is customary in most places to use either hot water at a temperature of about 140° F. or a mixture of hot water and steam while driving the points, and then to complete the thawing by means of steam alone, since by employing hot water in a part of the operation the atmosphere of the mine does not become so vitiated through

the condensation of the steam and the conditions for working are consequently better.

Hot-water hydraulicking by means of the pulsometer or other steam pump has been very successful in some places. Pulsometers in use in 1905 were reported to do the work of 20 points, and as by this method a jet of hot water is thrown forcefully against the frozen face, the gold particles are more easily released from adhesive material in which they may be embedded than by the use of points. Pulsometers are generally suspended in a sump at the bottom of the shaft, and the hot water is supplied by siphon from the boiler. Surplus water is generally removed by centrifugal pumps. It seems probable that hot-water hydraulicking will be more generally employed.

After thawing, the gravel is removed with pick and shovel and carried by wheelbarrows to the shaft, whence it is hoisted to the surface by buckets attached generally to an automatic trolley. In summer it is conveyed directly to the sluice boxes, or, when the water for sluicing is available for only part of the shift, to a hopper connected with the set of boxes. In winter the gravel is conveyed to a dump under which sets of boxes have been arranged and later, in the spring, it is passed through the sluices. Ground which stands well without timbering is worked both winter and summer, but summer work is cheaper. Ground having a tendency to cave is often left for winter exploitation, as it is found that the expense of rehandling in the spring is more than counterbalanced by the greater facility with which the gravel can be extracted.

The ordinary sluice boxes with pole riffles are universally employed, usually 12 by 14 inches in cross section and 12 feet long. An average size dump box or rock box is 20 to 22 feet in length and 36 to 40 inches or more in width. This catches from 60 to 90 per cent of all the gold saved, and most of the remainder is caught in the next three boxes, which have grades generally ranging from 9 to 12 inches to the box. Ordinarily two clean-ups a week are made. The concentrates are dried in mining pans on stoves or blacksmiths' forges, and as a rule are cleaned by dry panning and blowing.

COSTS.

The cost of mining under conditions in 1905 was so great that most of the ground worked had to carry in the pay streak values of at least 2 cents to the pan, or approximately $2.75 to the cubic yard. Most of the claims are 1,500 feet in length, measured parallel with the courses of the creeks on which they are located, and there are generally two or three outfits working on a single claim. At many claims the ground is worked by laymen, who give from a third to a half of the output to the owners.

The prevailing wage for miners is $5 a day and board, but in some places it reaches $6 a day and board. The duty per man per day of ten hours is from 75 to 100 wheelbarrows of dirt broken down with the pick, shoveled into a wheelbarrow or cars, and delivered to the shaft bucket; the average is probably about 9 cubic yards a day, but under very favorable conditions for short periods of time this quantity may be nearly doubled. The conditions under which work in the drifts is carried on vary with the character and form of the deposit. Where the pay streak is thin the drifts are made as low as possible to avoid removing more waste than is absolutely necessary, from which it is seen that the most favorable conditions occur when the pay streak is of such a thickness, 6 feet or more, that on its removal there is space for perfect freedom of movement and sufficient ventilation.

SUMMARY.

Although up to 1905 the producing creeks were few and comparatively short and most of the deposits were so deep and so consolidated by ice that machinery and much time were required for their development, the returns were for the most part satisfactory. The introduction of much machinery met with a quick response in a greatly increased production. With the lower cost of mining resulting from increased facilities in transportation, there is the opportunity every season of working ground containing lower values; there are, further, the potentialities of the undeveloped creeks which have just become producers, and the possibilities of new discoveries.

The problem of water supply is becoming more important every year, and has led to extensive plans, to which reference has already been made, for bringing water from the upper valley of the Chatanika. An inspection of the map shows a considerable difference between the level of Beaver Creek at the great bend and that of streams to the south and southeast, tributary to the Tanana, and this has been suggested by R. B. Oliver as an important possible source of water supply.

WATER SUPPLY OF THE FAIRBANKS REGION, 1907.

By C. C. COVERT.

The future development of the Fairbanks mining district depends more or less on the economical development of its water resources. Most of the producing creeks have small drainage areas and will furnish but a scanty water supply, especially during the dry season.

During July and part of August, 1907, the operators were obliged to resort to various schemes to procure sufficient water for sluicing. In some places the water was returned for a second and third time to the sluice box by means of the steam pump, entailing extra expense

both in fuel and equipment, and on a number of the creeks only about half of the mines were in operation.

In the early days of the camp, when but a few operators were at work on each stream and its watershed was well protected by timber, little thought was given to the supply of water for the sluice box, but as the camp developed from year to year and the demand for water was greatly increased it became evident that a larger supply must be procured. Consequently, as with other and older camps, numerous ditch lines were planned to bring water into the district.

The general topography of the country is such that ditch lines from the larger drainage areas are not practical. (See map, Pl. I.) Most of the producing creeks rise in a high, rocky ridge, of which Pedro Dome, with an elevation of nearly 2,500 feet above sea level, is the center. At least 50 per cent of the mining is done at an elevation of over 800 feet and 25 per cent above 1,000 feet. The drainage basins of sufficient area and elevation to supply water to the upper reaches of these producing creeks lie at a distance of more than 50 miles in a direct line and over 100 miles by ditch line. The cost of building and maintaining such ditches, especially as they could furnish but a moderate supply of water, would be excessive.

In the older mining camps of Alaska, especially those of Seward Peninsula, many hydraulic enterprises have failed owing to the lack of reliable information concerning the available water supply. In order that like failures may be avoided in the Tanana Valley, the United States Geological Survey, during the summer of 1907, extended to the Fairbanks district the stream-gaging work started in the Nome region in 1906 and continued there this year.

The field work in the Fairbanks district was carried on from June 20 to September 15 and the region covered includes the drainage basins of Little Chena River, Goldstream Creek, Chatanika River, Beaver Creek, and Washington Creek, comprising an area of approximately 2,200 square miles. Owing to the lack of adequate funds the work was largely of a reconnaissance character. However, the keeping of systematic records on some of the more important streams was made possible through the hearty cooperation of the people interested. Among the many who rendered valuable assistance in procuring the data given in the accompanying tables are Mr. John Zug, superintendent of the good roads commission; Mr. A. D. Gassaway, general manager of the Chatanika Ditch Company; Mr. Falcon Joslin, president of the Tanana Mines Railroad; Mr. Herman Wobber, Fairbanks Creek; Mr. C. D. Hutchinson, electrical engineer, Tanana Electric Company; and Mr. Martin Harris, Chena.

After making a careful study of the general topographic conditions of the mining district proper and its surrounding country it was decided to establish a few regular stations at the most convenient

points in the larger drainage areas and study the daily run-off during the open season from records thus obtained. This plan afforded greater opportunities for procuring comparative data than that of covering a larger territory in a less definite way. In this country without storage, daily records are an important factor, and such records could not have been obtained over an extended area. Outside of the producing creeks the country is almost a wilderness, and it is practically impossible to get observations other than those which would be made on the occasional visits of the engineer. No daily or even weekly records could have been assured, and the results obtained from scattering measurements would have furnished no comprehensive idea as to what the daily run-off of the streams really was throughout the open season.

On account of the location of the stations the results published in the following tables have a more direct bearing on the development of water power for electric transmission than on that of a water supply to ditch lines for hydraulicking, though a properly constructed ditch may furnish water for either or both.

The records kept on the upper Chatanika establish the fact that the volume of water is more nearly what would be required for a ditch supply than that of any other drainage area within a practicable distance of the Fairbanks district, except that of Beaver Creek. While the upper Chatanika may thus be considered for furnishing water to the Fairbanks district, the supply would have to be conveyed for more than 100 miles through a ditch line difficult to construct and maintain before it would be available for use, and then on account of the low head but a small number of the producing creeks would be benefited. The Beaver Creek basin would furnish a greater supply at perhaps a higher elevation, but its greater distance from the seat of operations makes it a less practical source of water than the Chatanika.

From the data at hand it appears that hydro-electric development is the most practical solution for the various industrial problems of the camp. Electric power could be readily transmitted to the various creeks and easily supplied to the individual miner as a cheap and practical power for pumping water to the sluice box, for running the hoist, for elevating the tailings, for pumping water out of the mines, for lighting the underground work, and in some localities for supplying power to the dredge.

The following tables indicate in a general way the work done in the Fairbanks district during the past season. A more detailed report of the work done in this territory will be published in a water-supply paper of the United States Geological Survey.

Table 1 gives a list of discharge measurements made at the several gaging stations together with the approximate elevation above sea

level, the drainage area in square miles above the gaging station, and the discharge in cubic feet per second.

Table 2 gives the daily discharge in second-feet at the regular gaging stations. Second-feet is an abbreviation for cubic feet per second. A second-foot is the rate of discharge of water flowing in a stream 1 foot wide, 1 foot deep, at a velocity of 1 foot per second.

The " miner's inch " expresses the rate of discharge of water that passes through an orifice 1 inch square under a head which varies locally, that commonly used in the Fairbanks district being 6 inches. To obtain the discharge in miner's inches multiply the cubic feet per second by 40.

Table 3 gives the drainage area in square miles above the gaging station and the mean run-off in second-feet per square mile; $\frac{(22\text{–}31)}{0.577}$ signifies that the records covered the period from the 22d to the 31st of the month and that the mean run-off was 0.577 second-foot per square mile for that period.

TABLE 1.—*Discharge measurements made in the Fairbanks district in 1907.*

Date.	Stream.	Locality.	Elevation above sea level.	Drainage area.	Gage height.	Discharge.
			Feet.	*Sq. miles.*	*Feet.*	*Sec.-ft.*
July 21	Fish Creek	Above Fairbanks Creek	925	39	1.00	23.7
July 25	do	do			.99	21.2
August 3	do	do			1.55	47.8
August 4	do	do			1.35	37.6
August 19	do	do			1.00	20.8
June 24	Fairbanks Creek	Near Crain Creek				1.4
Do	do	Near claim 2 above				2.2
July 5	do	Near claim 9 above				.72
July 20	do	Near Claim 10 above				1.30
Do	Bear Creek	Near Tecumseh	900	12		8.4
August 22	do	do				7.0
July 6	Miller Creek	Near mouth	750	15		7.0
July 24	do	do				7.6
August 20	do	do				8.0
August 6	do	Just below Heim Creek	790	10		8.0
August 7	do	do				8.0
Do	do	Just above Heim Creek	800	6		4.9
July 23	Elliott Creek	Near mouth of Sorrel Creek.	800	13.8	1.6	5.1
August 5	do	do			1.85	13.8
August 20	do	do			1.615	7.1
July 23	Sorrels Creek	Near mouth	800	21	1.0	10.3
August 5	do	do			1.4	28.2
August 20	do	do			1.02	12.0
July 22	Little Chena River	Above mouth of Elliott Creek.	800	79	.60	44.2
July 24	do	do			.565	39.7
August 4	do	do			1.10	113.0
August 5	do	do			1.05	103.0
August 20	do	do			.73	56.7
June 21 [a]	Goldstream Creek	Lower line of claim 6 below.	886	28.6		12.3
June 28 [a]	do	do				22.4
June 28	Goldstream ditch	Below intake				10.8
Do	Fox Creek		900			2.0
June 27	Ditch on Dome Creek	Near claim 2 below		7		.84
June 26	Little Eldorado			4		.45
July 4	Cleary Creek	Near Cleary		10.5		2.9
July 10	McManus Creek	At mouth	1,375	80		15.6
Do	do	do				16.4
July 12	do	500 feet above mouth of Smith Creek.	1,400	42		10.2
Do	do	At mouth	1,375	80		15.6
July 13	do	¾ mile above Montana Creek.	2,000	8		1.8

[a] Includes flow through small sluice box that diverts water from creek above gaging station.

TABLE 1.—*Discharge measurements, etc.*—Continued.

Date.	Stream.	Locality.	Elevation above sea level.	Drainage area.	Gage height.	Discharge.
			Feet.	*Sq. miles.*	*Feet.*	*Sec.-ft.*
July 13	McManus Creek	Just below Montana Creek.	1,975	10		3.8
Do	do	1½ miles below Idaho Creek.	1,800	26		6.5
Do	do	½ mile above mouth	1,380			21.4
July 14	do	500 feet above mouth of Smith Creek.	1,400	42		12.4
Do	do	½ mile above mouth	1,380			19.4
July 12	Smith Creek	Near mouth	1,400	34		7.8
July 14	do	do				8.7
Do	do	Above mouth of Pool Creek.	1,450	17.0		5.4
Do	Pool Creek	Above mouth		14.0		2.4
Do	Charity Creek	1 mile above Hope Creek.				5.7
Do	Hope Creek	Near Zephyr				7.7
July 16	Chatanika River	Below Faith and McManus creeks.	1,350	132	1.58	51.9
July 26	do	do			1.805	80.5
August 3	do	do			1.89	96.5
August 7	do	do			2.255	188
August 15	Boston Creek	1 mile above mouth	800	6.5		3.9
Do	McKay Creek	do	800	6.2		3.7
Do	Belle Creek	do	800	11		10.0
July 9	Kokomo Creek	do	750	26		13.8
August 14	do	do				22.7
July 27	Poker Creek	½ mile above mouth		40	1.09	22.3
July 30	do	do			1.10	22.6
August 9	do	do		40	1.32	36.6
August 10	do	do			1.33	37.8
Do	do	1 mile above Caribou				21.1
Do	Little Poker Creek	Near mouth				3.9
Do	Caribou Creek	Above Little Poker Creek.				10.4
June 22	Chatanika River	Below mouth of Poker Creek.	700	456	1.08	246
July 4	do	do			.83	178
August 9	do	do			1.98	669
August 27	Trail Creek	About 3 miles above mouth.	1,700	27		39.9
Do	Brigham Creek	1 mile above mouth	1,500	15		16
August 28	Fossil Creek	Near mouth				19.2
August 29	Bryan Creek	5 miles above mouth	1,800	48		75.3
August 30	Beaver Creek, R. Branch.		1,800	122		267
Do	Beaver Creek, L. Branch.		1,800	67		124
Do	Nome Creek	¾ mile above mouth	1,700	120		135

TABLE 2.—*Daily discharge in second-feet of various streams in Fairbanks district, 1907.*

JUNE.

Day.	Goldstream Creek.	Faith Creek.	McManus Creek.	Chatanika River below mouth of Poker Creek.	Day.	Goldstream Creek.	Faith Creek.	McManus Creek.	Chatanika River below mouth of Poker Creek.
20	10.8	44.7	34.8	250	27	6.4	34.4	24.3	192
21	10.8	44.7	34.8	250	28	20.7	45.9	31.1	216
22	9.3	42.8	31.2	250	29	30.2	43.6	26.0	250
23	4.9	39.3	34.8	250	30	26.3	36.8	23.2	216
24	7.8	38.8	25.0	232					
25	7.8	35.3	21.7	216	Mean	13.4	40.5	28.5	228
26	12.3	36.5	25.0	192					

TABLE 2.—*Daily discharge in second-feet of various streams, etc.*—Continued.

JULY.

Day.	Fish Creek.	Elliott Creek.	Sorrels Creek.	Little Chena River.	Goldstream Creek.	Faith Creek.	McManus Creek.	Chatanika River, near Faith Creek.	Kokomo Creek.	Chatanika River, below mouth of Poker Creek.
1	....	....	....	....	20.7	32.6	21.6	....	....	192
2	....	....	....	....	12.3	28.5	20.1	....	....	192
3	....	....	....	....	10.8	26.4	19.0	....	....	192
4	....	....	....	....	9.3	24.8	18.5	....	....	167
5	....	....	....	....	4.9	22.1	17.8	....	....	167
6	....	....	....	....	3.6	21.6	16.1	....	....	167
7	....	....	....	....	15.4	22.0	17.5	....	....	167
8	....	....	....	....	12.3	20.8	17.8	....	....	204
9	....	....	....	....	10.8	20.1	15.8	....	13.9	180
10	....	....	....	....	6.4	19.2	15.0	....	10.9	167
11	....	....	....	....	32.2	21.0	16.1	....	25.8	192
12	....	....	....	....	30.2	20.5	15.0	....	19.8	192
13	....	....	....	....	17.1	20.1	15.4	....	19.8	204
14	....	....	....	....	13.8	21.0	17.8	....	16.8	192
15	....	....	....	....	34.4	20.9	18.5	....	16.8	216
16	....	....	....	....	28.2	21.7	19.0	....	16.8	232
17	....	....	....	....	18.9	35.3	21.6	60	13.9	250
18	....	....	....	....	15.4	35.0	34.7	90	19.8	250
19	....	....	....	....	12.3	62.5	40.0	80	13.9	283
20	....	....	....	....	12.3	43.9	31.6	73	13.9	266
21	....	....	....	....	10.8	38.6	26.0	66	13.9	250
22	24	5.8	10.3	42	9.3	31.4	21.2	57	10.9	250
23	24	5.8	10.3	42	7.8	25.5	17.8	54	7.9	204
24	24	5.8	10.3	42	12.3	28.8	21.4	60	13.9	192
25	24	5.8	10.3	42	9.3	26.4	19.1	73	10.9	192
26	27	9.0	14.7	80	9.3	61.0	38.6	88	13.9	232
27	24	9.0	14.7	66	6.4	42.0	29.1	73	13.9	250
28	21	5.8	10.3	53	6.4	28.4	23.9	63	13.9	250
29	21	5.8	10.3	42	4.9	30.6	21.8	60	10.9	250
30	18	4.1	8.2	42	4.9	26.7	18.8	54	7.9	216
31	18	2.5	6.0	42	2.2	25.0	16.7	54	7.9	192
Mean	22.5	5.94	10.5	49.3	13.1	29.2	21.4	67	14.2	211

AUGUST.

Day.	Fish Creek.	Elliott Creek.	Sorrels Creek.	Little Chena River.	Goldstream Creek.	Faith Creek.	McManus Creek.	Chatanika River, near Faith Creek.	Kokomo Creek.	Chatanika River, below mouth of Poker Creek.
1	155	9.0	14.7	53	30.2	36.4	81.2	80	12	752
2	100	23	27.8	157	32.2	41.1	80.8	122	68	1,160
3	39	23	27.8	113	20.7	35.9	56.1	92	43.8	680
4	35	17.2	32.1	113	15.4	34.7	51.2	101	37.9	530
5	37	12.3	25.6	113	13.8	42.5	63.4	106	31.8	530
6	39	12.3	23.4	95	15.4	40.6	60.6	106	31.8	480
7	47	12.3	23.4	104	24.4	87.4	98.6	186	34.8	405
8	35	12.3	23.4	113	26.3	62.7	84.3	147	31.8	530
9	50	15.6	27.8	134	22.5	52.4	75.6	128	43.8	620
10	50	12.3	23.4	113	32.2	44.2	77.8	122	37.9	590
11	39	12.3	23.4	95	26.3	39.0	62.2	101	31.8	455
12	31	9.0	19.0	80	15.4	35.0	49.8	88	28.9	405
13	27	12.3	19.0	95	13.8	42.8	45.5	88	25.8	342
14	27	12.3	19.0	66	12.3	35.6	40.0	80	22.7	363
15	27	9.0	14.7	80	12.3	33.6	37.2	80	....	300
16	24	9.0	14.7	66	13.8	34.4	42.4	80	....	283
17	24	9.0	14.7	66	10.8	30.8	39.0	80	....	250
18	24	7.4	12.5	60	10.8	30.6	37.4	78	....	250
19	24	7.4	10.3	60	10.8	28.5	34.7	73	....	216
20	24	5.8	10.3	53	13.8	27.8	33.6	73	....	250
21	24	5.8	10.3	53	18.9	26.9	32.2	73	....	250
22	24	5.8	10.3	53	20.7	44.2	68.7	111	....	216
23	24	5.8	10.3	53	20.7	39.4	50.3	101	....	266
24	24	5.8	10.3	53	20.7	49.8	67.1	122	....	283
25	27	7.4	12.5	73	18.9	62.8	81.2	177	....	342
26	27	9.0	14.7	95	22.5	82.6	102	186	....	430
27	24	9.0	14.7	80	20.7	69.3	92.6	154	....	321
28	24	12.3	19.0	80	22.5	62.6	91.2	147	....	363
29	27	12.3	19.0	88	26.3	70.5	114	186	....	430
30	31	12.3	19.0	95	28.2	72.5	112	186	....	505
31	27	12.3	19.0	95	28.2	67.8	94.1	186	....	455
Mean	36.8	11.0	18.2	85.4	20.0	47.5	66.4	117	41.6	428

TABLE 2.—*Daily discharge in second-feet of various streams, etc.*—Continued.

SEPTEMBER.

Day.	Fish Creek.	Elliott Creek.	Sorrels Creek.	Little Chena River.	Goldstream Creek.	Faith Creek.	McManus Creek.	Chatanika River, near Faith Creek.	Kokomo Creek.	Chatanika River, below mouth of Poker Creek.
1	24	12.3	19	95	18.9	59	71.5			384
2	24	12.3	19	80	17.1	52.5	62.8			363
3	24	9.0	14.7	80	17.1	50.2	57.8			321
4	24	9.0	14.7	66	18.9	66.4	57.2			321
5	27	9.0	14.7	80	20.7					300
6	27	9.0	14.7	88	17.1					321
7	27	9.0	14.7	88	17.1					321
8	27	9.0	14.7	95	15.4					321
9	27	10	14.7	95	17.1					384
10	35	12	19	95	15.4					321
11	(a)	(a)	(a)	(a)	22.5					342
12					36.6					2,160
13					36.6					3,160
14					28.2					1,780
15					28.2					1,390
16					41.0					2,620
17					30.2					2,980
18					26.3					942
19					20.7					1,060
20					32.2					901
21					26.3					942
22					24.4					901
23					30.2					860
24					26.3					788
25					24.4					680
26					24.4					680
27					20.7					680
28					18.9					680
29					22.5					788
30					24.4					942
Mean	26.6	10.0	16.0	86.2	24.0					954

OCTOBER.

Day.	Goldstream Creek.	Chatanika River below mouth of Poker Creek.	Day.	Goldstream Creek.	Chatanika River below mouth of Poker Creek.
1	20.7	860	10		232
2	20.7	680	11		384
3	24.4	590	12		590
4	20.7	530	13		560
5	20.7	505	14		530
6	20.7	480	15		(b)
7	17.1	455			
8	(b)	384	Mean	20.7	506
9		300			

[a] No records for remainder of season.

[b] Stream frozen over.

TABLE 3.—*Mean run-off at various gaging stations in the Fairbanks district, 1907.*

Stations.	Elevation (feet).	Drainage area (square miles).	Mean run-off (second-feet per square mile).				
			June.	July.	Aug.	Sept.	Oct.
Fish Creek above Fairbanks Creek	925	39	....	(22-31) 0.577	0.944	(1-10) 0.682	....
Elliott Creek near mouth of Sorrels Creek	800	13.8	....	(22-31) .430	.797	(1-10 .724	....
Sorrels Creek near mouth	800	21	....	(22-31) .500	.867	(1-10) .762	....
Little Chena River above mouth of Elliott Creek	800	79	....	(22-31) .624	1.08	(1-10) 1.09	....
Goldstream Creek, lower line of claim 6 below	880	28.6	(20-30) 0.469	.542	.700	.826	(1-7) .724
Faith Creek near mouth	1,375	51	(20-30) .794	.572	.932	....	....
McManus Creek near mouth	1,375	80	(20-30) .356	.268	.830	....	....
Chatanika River near Faith Creek	1,350	132	....	(17-31) .508	.886	....	....
Kokomo Creek near mouth	750	26	....	(9-31) .546	(1-14) 1.60	....	....
Chatanika River below mouth of Poker Creek	700	456	(20-30) .500	.463	.938	2.09	(1-14) 1.11

In connection with these investigations the following rainfall stations were established:

Summit Road House near Pedro Summit, elevation 2,310 feet.
Cleary, elevation 1,000 feet.
Chatanika River near mouth of Poker Creek, elevation 730 feet.
Chatanika River near mouth of Faith Creek, elevation 1,400 feet.

The results of the observations taken at these stations, together with other records kept in the Tanana and Yukon basins in 1907, are as follows:

TABLE 4.—*Daily rainfall, in inches, at stations in Fairbanks district, 1907.*

Day.	May.	June.	July.				August.					September.		
	Fairbanks village.	Fairbanks village.	Fairbanks village.	Summit Road House.	Cleary.	Chatanika River near Faith Creek.	Fairbanks village.	Summit Road House.	Cleary.	Chatanika River near Poker Creek.	Chatanika River near Faith Creek.	Fairbanks village.	Cleary.	Chatanika River near Poker Creek.
1	......	......	......	......	......	......	0.72	1.27	1.17	(a)	0.49	......	......	......
2	......	......	......	......	......	0.02	.01	.06	.12	(a)	.19	......	......	Tr.
3	......	......	0.04	......	0.09	......	......	......	......	(a)	......	......	......	......
4	......	......	......	......	......	......	......	......	.09	(a)	.20	0.18	0.08	0.10
5	......	0.15	......	......	......	.04	......	......	......	(a)	.03	.03	.14	......
6	......	.09	......	0.30	......	......	.13	.27	.04	0.05	.11	......	......	......
7	......	.11	.35	.06	.30	.14	......	.07	.22	.24	.15	......	.12	.01
8	......	.07	.01	......	.09	......	.01	.42	......	......	.15	.18	.11	.02
9	0.15	......	......	......	......	......	......	.11	.46	.33	.10	.02	.22	.01
10	......	.15	......	.50	.47	.03	.25	......	.08	.05	.02	.05	......	Tr.
11	......	.05	.02	.12	.09	.14	......	......	......	......	......	.23	......	.63
12	......	......	.05	.22	.32	......	......	......	......	......	......	.71	.21	.88
13	.06	......	......	......	......	.03	......	......	......	......	.01	......	.80	......
14	......	......	......	.30	......	.05	......	......	......	......	......	......	......	......
15	......	.02	.01	.05	.19	.28	.09	......	......	......	.07	.22	.85	.70
16	......	.18	.19	.24	.20	.11	......	......	......	.01	.04	.27	......	.10
17	......	.10	......	.03	.01	.01	......	.09	......	.01	......	......	......	......

[a] No record.

TABLE 4.—*Daily rainfall, in inches, at stations in Fairbanks district, 1907*—Con.

Day.	May.	June.	July.				August.					September.		
	Fairbanks village.	Fairbanks village.	airbanks village	Summit Road House.	Cleary.	Chatanika River near Faith Creek.	Fairbanks village.	Summit Road House.	Cleary.	Chatanika River near Poker Creek.	Chatanika River near Faith Creek.	Fairbanks village.	Cleary.	Chatanika River near Poker Creek.
18		0.02	0.09	0.24	0.15	0.35	0.12		0.05	0.07	0.01			
19				.13										
20			.14			.13						0.15	0.15	0.40
21								0.19		.13		.15		.13
22			.01				.05	.04	.10	.02	.13	.16	.52	.27
23								.20	.11	.13		.37	.23	.15
24			.25	.22	.27	.23	.18	.13	.09	.04	.15			
25			.18	.15			.12	.03	.13	.15	.36			
26			.05	.02	.12	.31					.03			
27					.07									
28		.23						.26		.02	.09			
29	.13	.30		.13	.06		.13	.13	.22	.15	.54		.39	.30
30	.01		.12		.12						.13			
Total	.35	1.47	1.51	2.71	2.55	1.87	1.81	3.27	2.88		3.00		3.82	3.70

TABLE 5.—*Monthly precipitation, in inches, at stations in drainage basin of Tanana River, 1907.*

	Jan.[a]	Feb.[a]	Mar.[a]	Apr.[a]	May.	June.	July.	Aug.	Sept.
Cleary							2.55	2.88	3.82
Chatanika River, near Poker Creek									3.70
Chatanika River, near Faith Creek							1.87	3.00	
Fairbanks	3.30	0.86	2.42	0.03	0.35	1.47	1.51	1.81	
Summit Road House							2.71	3.27	
Summit (headwaters Tanana)	1.8	.10		.40	.80	2.15			

[a] Records for these months are practically 10 per cent of snowfall.

TABLE 6.—*Monthly precipitation, in inches, at stations in drainage basin of Yukon River, 1907.*

	Jan.[a]	Feb.[a]	Mar.[a]	Apr.[a]	May.	June.	July.	Aug.	Sept.
Central House	1.04	0.42	2.57	0.93	0.57	2.21	1.40		
Circle	1.02	.57	.28	.15	2.29		1.36	2.79	1.73
Fort Egbert (Eagle)	1.45	.20	0.0	.15	.40	1.89	1.48	1.98	
Fort Gibbon	1.26	.21	.53	0.0	.30		2.58	2.31	2.32
Holy Cross Mission	2.08	.55	4.49			2.95	3.73	5.39	
Ketchumstock	.12	.20	.27	Tr.	1.3	2.03	1.60	2.14	
North Fork	.69	.28	.27	Tr.	1.34	1.92	1.57	3.19	2.0
Rampart	1.17	.44	1.17	.02	.44	1.64	2.29	3.38	

[a] Records for these months are practically 10 per cent of snowfall.

SALCHA REGION.

The area drained by streams in the southeastern part of the Fairbanks quadrangle has been under investigation by prospectors for several years. The bed rock throughout this region consists essentially

of schists, gneiss, crystalline limestone, some greenstone, serpentine, and intrusive hornblende granite.

Tenderfoot is the only creek that up to the present time (1907) has proved productive. Steamers run occasionally from Fairbanks to the mouth of Banner Creek and supplies are thence carried by pack train a distance of about 3 miles to Tenderfoot Creek. The creek is only about 6 miles long and carries probably not more than 3 to 4 sluice heads of water. It flows for a part of its course in a narrow channel in the muck 15 to 20 feet below the valley floor, which is a quarter of a mile or more wide and has a grade of about 100 feet to the mile. There are remnants of a bench of soft deposits in parts of the valley just to the west of the creek and about 40 feet above it. The valley is filled with deposits ranging, in the prospect holes that were being sunk in 1905, from 48 to 120 feet in thickness. The overlying muck is from 36 to 80 feet thick. The gravels are similar to those of the Fairbanks region and comprise quartzite schists, mica schist, carbonaceous schist, feldspathic schist, and granite.

RAMPART REGION.

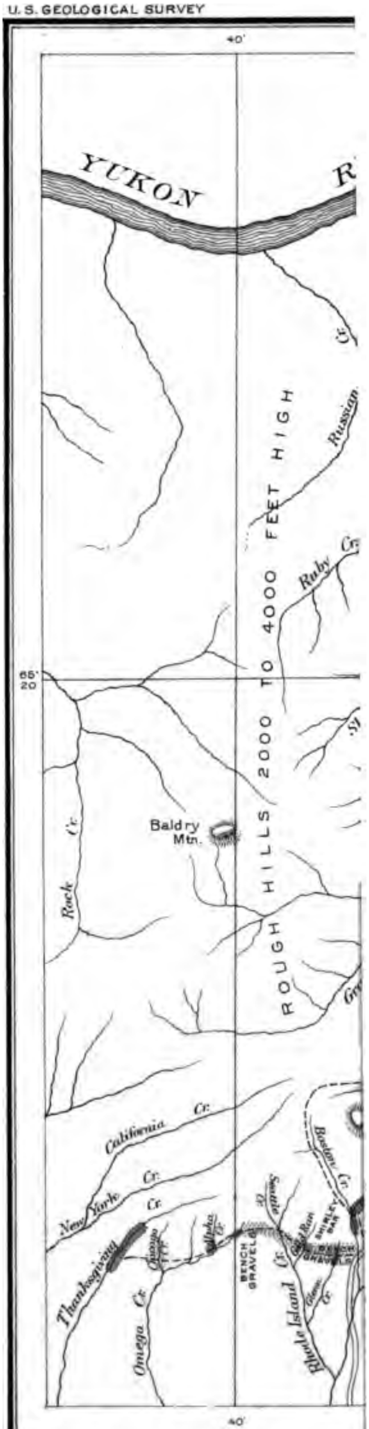
GENERAL STATEMENTS.

The Rampart region (see Pl. II) is about 80 miles northwest of the Fairbanks region, and all the creeks of present economic importance are within 30 miles of the Yukon and belong to the drainage systems of both the Yukon and the Tanana.

The region has passed through many stages characteristic of the life of a placer camp. Some of the creeks were prospected as early as 1893 and were active producers by 1896, when the region became of equal prominence with the Fortymile and Birch Creek regions. Many were attracted by the favorable results, and during the winter of 1898–99 the town of Rampart, the suply point of the camp, contained about 1,500 people. After the preliminary stage of prospecting and the subsequent excitement of the boom days, with their excess of hopes and population, the camp settled down to the laborious existence of an average producer, influenced from time to time by the discoveries of gold in other portions of Alaska and rewarded occasionally by discoveries in its own territory. Discoveries have recently been made which have contributed to the permanence of the camp and illustrated the possibilities still existing in a region which has already been under investigation for several years. The introduction of hydraulic methods, too, entailing the expenditure of considerable capital, has given further importance to this region.

The town of Rampart, with a population of a few hundred, is on the south bank of the Yukon, 170 miles below Circle and about 70 miles above the junction with the Tanana, at a point where the

U. S. GEOLOGICAL SURVEY



Yukon, after pursuing for a few miles a southerly course, bends squarely to the west and sweeps in a deep channel past the hills which bound the south side of the rather open valley. A narrow-terraced slope between these hills and the river is picturesquely occupied, along the water front and the hillside in the background, by the irregular collection of buildings that forms the town. There is an air of importance about the place, and it possesses, also, a kind of dignity which the pervasive majesty of the great river and the vast loneliness of the country through which it flows have conferred upon every one of these small isolated outposts of civilization.

Conditions in the Rampart region during 1906 [a] were as follows:

The total gold output of the Rampart district for 1906 is estimated to have a value of $270,000. The writer is indebted for valuable information to Messrs. H. F. Thumm and E. H. Chapman, of Rampart. Mr. Thumm states that about 33 claims were worked during the winter of 1906 and 17 during the summer, giving employment to about 100 men in winter and about twice as many in summer. New creeks not producing last year are Boothby and Skookum.

Three hydraulic plants were operated during part of the summer, one each on Hoosier, Ruby, and Hunter creeks. The Alaska road commission has begun the construction of a highway from Rampart up Big Minook. This when completed will materially reduce the cost of all mining operations.

Another road has been built from Baker Hot Springs to Glenn Creek, a distance of 24 miles, by Thomas Manley, a large owner of mining property. This road affords a natural outlet to Tanana River for the Glenn Creek region. Mr. Manley has also surveyed a ditch line from Hutlinana Creek to Thanksgiving Creek, a distance of 15 miles. If the scheme is carried out and there is sufficient water it will lead to extensive mining developments in the Glenn Creek region. It is of interest to note that the same operator has imported a churn drill for prospecting, the first in the district.

Baker Hot Springs, on a slough about 6 miles from the Tanana, was rapidly developing during 1906 as a supply point for the creeks. Since all the common vegetables can be grown there it has become a productive center of supplies for both the Fairbanks and the Rampart regions. Twelve acres were under cultivation in the vicinity of the hot springs and about 50 acres had been prepared for cultivation. Although the most favorable conditions for cultivation prevail in the vicinity of the hot springs, on what is called the warm ground, where a large variety of vegetables can be grown, there are large areas of cold ground where the common vegetables like cabbage, beets, radishes, and potatoes can be grown in abundance.

There is a station of the Government telegraph line at Rampart and another at Hot Springs, and these afford communication with other portions of Alaska and the outside at rates which are low in comparison with the advantages which may thus be secured.

The total production of the Rampart region, including that of 1906, is approximately $1,582,000.

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[a] Brooks, A. H., Bull. U. S. Geol. Survey No. 314, 1907, pp. 37–38.

During 1907 there was much activity on the southern side of the divide and the discoveries on Patterson Creek indicate the possibility of another productive area.

BED ROCK.

Most of the gold-producing creeks tributary to Minook Creek from the east head in areas composed of slates, quartzites, feldspathic quartzites, chert, and sheared chert derivatives, and flow in the lower parts of their valleys through areas of greenstone, which are largely tuffaceous. The schistose, fine-grained fragmentals, alternating with the slates and quartzites, form the greater part of the bed rock in the valleys of the streams tributary to Baker Creek. The same rocks strike northeastward and occupy large areas in the valleys of the headwaters of the Tolovana, which were traversed by the Brooks party in 1902, and still farther in the same direction are found in the White Mountain section. There is no essential difference in the bed rock of the northern and southern sides of the divide in the Rampart region, except that the greenstones are confined mostly to the northern side in the lower part of Minook Valley below Florida Creek.

ALLUVIAL DEPOSITS.

The alluvial deposits of the Rampart region are in general much shallower than those of the Fairbanks region. They include muck and underlying gravels. The gravels reflect the variety of the bed rock and are present as both stream gravels and bench gravels. The stream gravels are composed of both angular and subangular material from the bed rock and well-rounded material from the benches. Bowlders at some localities are rather common. Bench gravels are of common occurrence, and much of the mining at present is confined to them. In this respect the region differs from the Fairbanks region, where bench gravels are the exception. The bench gravels lie at various levels up to 600 feet or more above the streams, and the greatest thickness that has been determined is about 100 feet. The material is both fine and coarse and includes a large proportion of quartzite pebbles. The pay streak of the pay gravels is next to bed rock, or partly within it when this is blocky, or in the lowermost few feet of gravel. Prospects have been found at several localities in the high bench gravels of Minook Creek, but the distribution of gold in these gravels has not been determined. In the Baker area the pay of a part of the bench gravels at least occurs as a streak similar to that of the creeks. The gold is mostly well worn and on some creeks is associated with nuggets of silver.

SOURCE OF THE GOLD.

A large part of the gold in the stream gravels has been concentrated from the bench gravels. The occurrence of gold has not been directly traced to a definite relation to any particular bed rock or to the quartz seams, which are rather common in the slates. Many of the dikes are more or less mineralized, and some of them are reported to carry values. Light-colored acidic dikes like those of the Fortymile region, with associated quartz veins, were not observed in the Rampart region. The slates contain generally a large amount of carbonaceous matter, and anthracitic material is common in some of the small quartz seams. Pyrite is often found in both the slates and the quartz seams. On creeks where the conditions are apparently least complex the only rocks observed were carbonaceous slates and grits with quartz seams, which occasionally are a foot or more in thickness, and the monzonitic intrusives in the ridge about the headwaters. Many of the nuggets have a considerable quantity of quartz attached, and it seems probable that the gold has been derived from the small quartz seams. The only general fact which seems to emphasize itself is that the occurrence of gold in quantities of economic importance is limited to an area where deformation of the rocks has been intense and where there has been much igneous activity.

PLACERS OF THE RAMPART REGION.

By Frank L. Hess.

GENERAL STATEMENT.

The placers of the Rampart region were studied by the Survey party for ten days during the first part of September, 1904. Every working claim was visited except those on Gunnison Creek, but in a number of cases where claims are worked only during the winter the operators could not be seen. Foot traverses were carried over the region and a sketch map was made (Pl. II). The time allowed only a hasty reconnaissance, though if it had been possible to know the dates of arrival and departure of the boats more time could have been put upon the study of region. The miners met were universally generous, hearty, and hospitable, ready to help whenever possible with information or otherwise, and the work was thus made much more effective and pleasant.

The placer diggings near Rampart may be grouped according to the drainage systems to which they belong. The three general groups, Minook Creek, Baker Creek, and Troublesome Creek, are separated by a divide having the general shape of a Y whose stem runs northeastward between the Minook and Baker Creek drainage, whose left arm runs nearly northward from Wolverine Mountain, about 13 miles southeast of Rampart (Pl. II), and whose right arm runs nearly eastward, from the eastern base of the mountain. Between the arms, extending northward, is the "Troublesome country," as the region surrounding the creek of that name is known from its steep, rocky ridges and deep, narrow valleys. Each group embraces only the diggings located on the creek that gives the group its name, or upon its tributaries.

In the Minook Creek group most of the gold-bearing creeks are on the east side, nearer the left-hand arm of the Y, only a few diggings being on the west side of the creek. In the Baker Creek group the diggings now known are on the side nearer the Y, and in the Trouble-

some Creek group the only diggings known are on the west side of the creek, on branches flowing from the left arm of the Y. The extreme length of the area containing known gold-bearing localities is about 30 miles and its greatest width is about 12 miles, the total area being probably less than 350 square miles.

Winter prospecting is being done on Squaw Creek, a tributary of the Yukon about the size of Minook Creek, which enters the river nearly opposite Rampart.

The first placer claim in the Rampart region was located and worked in 1896 on Little Minook Creek by F. S. Langford, though gold had been previously discovered by John Minook, a Russian half-breed, who seems to have sluiced out a small amount of gold, and for whom the creek was named. Some prospecting had probably been done along Minook Creek a number of years before. Since the first systematic work in 1896 the region has been a constantly productive one. Though the amounts taken out have not been so large as those mined at places in the Klondike district or at a few of the claims near Nome, yet a number of creeks in this region produce a fair amount of gold. At first Little Minook and Hunter creeks were the only producers, and during 1897 no new ground seems to have been found, but in 1898 a small amount was taken out of Quail Creek. Afterwards gold was discovered upon Little Minook Junior, Hoosier, Ruby, and Slate creeks of Minook Creek Valley. In the meantime prospecting was carried on over the divide on the south, and deposits along Baker Flats were discovered. In fact, each year has shown some new source of production, and it seems likely that more may still be found. The output to the fall of 1904, from the best available data, was $1,112,000, and that for the year ending at the same time was about $232,900.

As Rampart lies only about 1 degree south of the Arctic Circle, the cold of winter is severe and the open season is comparatively short. During the early part of June thawing is generally so far advanced that some preliminary work and sluicing can be done. Cold snaps are likely to make the work intermittent at first, but the latter part of June and all of July and August can be depended upon for outside operations. Frosts are likely to occur the first part of September, though mining can sometimes be carried on during practically the whole month. In 1904 the sluice boxes froze up on the 5th of September, and after that date there were only a few days on which sluicing could be done.

The surficial deposits are always frozen, and the limit of the frozen ground has not yet been reached, but there are channels in the frozen gravels through which water circulates freely at all seasons. Large masses of ground ice often occur in the muck, though none are found

in the gravels. The depth of the alluvial deposits sometimes exceeds 100 feet, but it is generally less than one-fifth of that amount.

The larger part of the mining has been carried on by drifting and open cuts, depending on the season and the local conditions, but during the season of 1904 two hydraulic plants began active operations, and two more were under construction. Ordinarily, wherever the gold-bearing alluvials are of sufficient depth they are mined by drifting during the winter and the dirt taken out is washed in the spring. In some cases the presence of water interferes very seriously with the drift mining and renders gravels otherwise workable comparatively valueless. Drifting can not ordinarily be carried on in the summer time, because the warm air melts the ground and causes it to cave. In thawing the ground for drift mining steam points have generally superseded wood fires, though the latter are still sometimes used.

During 1904 wages were $5 and board for a 10-hour day. This is equivalent to $6.50 to $9 a day, varying with the locality. The men who work for wages are generally strong and healthy and render a full equivalent for their pay.

The currency of the country, as in the early stages of most placer camps, is gold dust. The different values of the gold from the different creeks makes the fixing of the price at which it should pass rather difficult, and the result is that, while some gold passes considerably below its value, some passes at more than it is actually worth. The gold assays from $14.88 to over $19 per ounce, and passes at $15.50 to $18 per ounce.

MINOOK CREEK GROUP.

This group includes the placers of Minook Creek and its tributaries within limits of 5 to 13 miles from Rampart. Most of the diggings, and much the richest so far discovered in the group, are upon the east side of the valley, and none have been found in the main valley above the mouth of Slate Creek, 11 miles from Rampart.

The hills are generally rounded or flat-topped. The valleys are canyon-like, with steep walls 500 feet or more high, and benches are prominent features of the topography. The larger streams have cut their valleys down to a grade varying from 40 to 80 feet to the mile. The watershed of Minook Valley is narrow on the west, sometimes not over a half mile or a mile wide, and is probably at no place over 4 miles wide. On the east it is 5 to 7 miles wide through the greater part of the length of the creek.

The total production of the Minook Creek group has been about $702,600, of which $75,500 was produced during the winter of 1903–4 and $10,900 during the summer of 1904, making a total for the year of $86,400.

The surficial deposits are derived from the country rocks, mostly slate, quartzite, and greenstone, and reach occasionally a depth of over 100 feet, though usually much less than that, and there is generally a large proportion of muck.

MINOOK CREEK.

General description.—Minook Creek empties into the Yukon just east of Rampart, and is about 25 miles long. Near its mouth it is a shallow stream 50 or 60 feet wide, with a flow of possibly 200 second-feet or 8,000 miner's inches. It flows in a northerly direction through a deep valley whose width varies from a few hundred feet to about a half mile. The creek receives a number of large tributaries from the east—Hunter, Little Minook, Little Minook Junior, Hoosier, Florida, Chapman—and a number of creeks whose names are unknown. From the west it receives Montana, Ruby, Slate, and Granite creeks and a few small tributaries. Granite Creek, about 17 miles from the Yukon, is the largest western tributary, carrying probably 30 to 40 second-feet; Minook Creek carries perhaps 40 to 50 second-feet at the junction. These approximate estimates are given to convey some idea of the comparative sizes of the streams.

Aneroid barometer readings by Arthur J. Collier[a] showed a descent of about 760 feet from the "106 road house," about 1½ miles above Granite Creek, to the Yukon. As the distance is about 18 miles, these readings indicate a gradient of about 42 feet to the mile. In the next 3½ miles above he noted a rise of 240 feet, showing a gradient of about 68 feet to the mile. According to M. E. Koonce,[b] of Rampart, the creek has a fall of about 40 feet in the vicinity of the mouths of Ruby and Slate creeks. Aneroid barometer readings of L. M. Prindle and the writer showed a somewhat higher grade for the central portion of the creek. It seems likely that Minook Creek has an average gradient of somewhat over 40 feet per mile from the Yukon to Slate Creek and a somewhat steeper gradient above Slate Creek.

Just below the mouth of Slate Creek the Minook spreads into a number of branches in a wide gravel flat. This flat, which is typical of many Alaskan streams, is probably due to a change in the grade of the creek. The stream here is unable to carry the gravels of the swifter water above, and so spreads them upon the flat. Here are found the so-called "winter glaciers," which sometimes last through the short summers. In 1904 a quarter or half acre of ice still remained when the September frosts occurred. This ice owes its origin to the fact that the channel which carries the water is greatly con-

[a] Personal communication. In giving aneroid barometer readings their lack of reliability is recognized in all cases.

[b] Personal communication.

tracted by freezing in the fall. The resulting hydrostatic pressure cracks the ice and the water overflows and freezes. This process is repeated until a considerable thickness of ice is accumulated.

The valley is V-shaped in cross section, and the eastern slope is often benched, while the western is more abrupt and has remnants of benches at but few places. Five well-marked benches rise at irregular intervals above the floor between Little Minook Junior Creek and Hoosier Creek (fig. 3), the highest of which is about 500 feet. These benches are features of much importance in both the physiography and economic geology of the region. Important gravels cover the highest one, which lies on the east side of the Minook and extends from Hunter Creek to about a mile above Florida Creek. It will be described later. A small remnant of the same bench is found on the north side of the mouth of Montana Creek and another on the north side of the mouth of Ruby Creek. Other remnants are found on the north side of the mouth of Chapman Creek and at a point about

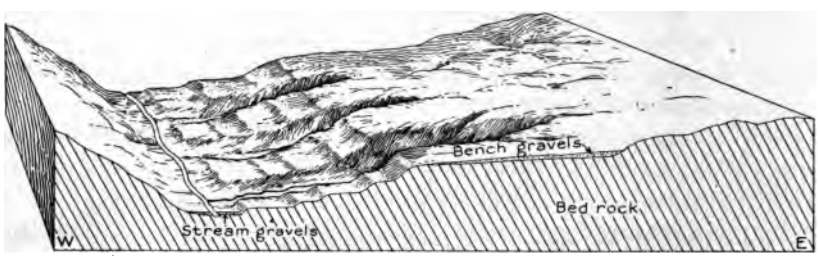


FIG. 3.—Diagrammatic sketch of Minook Valley.

4½ miles above the Chapman on the same side of Minook Creek. The last two benches show no gravel. On the west side of the creek but few remnants of benches are found. One, about 50 feet high, extends to a little above the mouth of Hunter Creek, and is probably an extension of a corresponding bench on the south side of the Yukon. It seems probable that all of the benches of Minook Creek may be more or less closely correlated with the benches of the Yukon. In the vicinity of the mouth of Slate Creek is a bench cut in the upturned slates and thin-bedded quartzites to a depth of 12 to 16 feet and covered by 4 or 5 feet of gravel and a foot or more of muck. No gravel has yet been found upon the benches of intermediate height, but further investigation may show its presence.

In its upper course the creek flows somewhat north of east for about 2 miles, and here the topography of its valley is altogether different from that of the lower part. The north side is a long, gentle slope with a greater rise in the upper part, while the south side is steep and the stream flows near its base. The asymmetry of this part of the valley is repeated in Eureka, Pioneer, Hutlina, Omega, New

York, California, and many other creeks of the region whose valleys lie in parallel or nearly parallel directions.

The rocks in the upper part of the valley are mostly closely folded slates and limestones. Garnetiferous schists occur at Ruby Creek, and greenstones form the bed rock of the lower valley except near the mouth, where they are partly covered by the Kenai rocks.

The alluvials of the valley are said to be 10 to 12 feet thick and consist of the usual muck (soil mixed with much vegetal matter), peaty soil, and gravel, with much angular débris at the foot of many of the hillsides. In the middle part of the valley they consist of about 5 to 6 feet of muck and the same thickness of gravel. The muck thickens toward the sides while the bed rock remains about level. The gravel deposits are derived from local bed rock and contain large numbers of smoothly rounded quartzite bowlders from a few inches to 3 feet in diameter, whose source has been a mystery to many. Some of these bowlders have undoubtedly descended to the present creek bed from the high benches already referred to, in whose gravels they are abundant.

The outcrop of quartzite near the "72 road house" would in itself seem sufficient explanation for the bowlders below, but above this point the thinner quartzite beds have added many more to the stream. The quartzites are so hard and their abrasion is so slow that while the other rocks wear into sand and small pebbles, or decompose and are swept away, the quartzite bowlders remain and make up a continually larger proportion of the gravels.

Mining.—Minook Creek has not produced a large amount of gold. The wide valley, large stream, and heavy gravels have made mining difficult, so that men with the limited means of the ordinary prospector have found it more advantageous to work the smaller streams. The total production to 1904 is placed by miners of the region at $9,900. The gold produced is said to have been taken from the central portion of the valley, partly from bar diggings and partly by drifting, but in general the gravels do not seem to be rich enough for working by pick and shovel methods.

Nothing was learned of the ocurrence of gold in the gravels of Minook Creek above the mouth of Slate Creek, except that colors have been found throughout its length. Below the mouth of Ruby Creek colors of gold are said to have been found in the gravels of a bench on the west side of Minook Creek, a few feet above the present stream, but not in paying quantity. The débris here is largely a carbonaceous slate somewhat schistose and highly impregnated with pyrites. An assay [a] of some of the material gave a trace of silver.

Two small areas worked in the gravels between Ruby and Slate Creeks are said to have given values of about $3 per square yard of

[a] Burlingame, E. E., & Co., Denver, Colo.

bed rock; another small area is said to have given $4 per square yard, and nuggets of values up to $90 are reported to have been found. The gold is stated to be practically all upon bed rock. The width of the gravel in which gold is found is not known, but it is supposed to occur throughout the gravels which floor the valley for a width of half a mile.

A company has been formed to hydraulic this portion of the creek; considerable preliminary work has been done, some pipe, lumber, etc., were on the ground September 20, 1904, and a large amount of pipe and other supplies for the company were brought to Rampart by the steamer *Susie* on her last trip up the Yukon for the season.

Several schemes were on foot for working the gravels in the lower part of the valley near the mouth of Hoosier Creek. One proposition was to work them with a dredger, and another with power scrapers. Little was learned of either plan, but from the roughness of the bed rock dredging would seem a difficult undertaking, except in the limited area in which the bed rock seems to be the Kenai sediments.

HIGH BENCH.

The high bench mentioned on the east side of Minook Creek, the most prominent feature of Minook Valley, needs to be treated here, as on its gravels depends probably in large measure the richness of most of the placers of the Minook region.

This bench, starting at a point about a mile above the mouth of Ruby Creek and about 9 miles in a straight line above the mouth of Minook Creek, continues to Hunter Creek, to a point within about 3 miles of the Yukon. The eastern line bounding the bench runs about N. 60° E., so that between Hunter Creek and Little Minook Creek the bench has a width of between 2½ and 3 miles. At its extreme eastern side the bench has a height of about 800 feet above Minook Creek, and it slopes toward the west until the height above the stream is only about 500 feet. The surface of the bench is remarkably smooth and continuous between the various streams that have cut across it, and resembles a plain through which deep ditches have been cut. It seems to narrow somewhat and crosses Hunter Creek at the mouth of "47 Pup" continuing in a northeast direction toward the Yukon. Although the writer was unable to follow the bench farther than Hunter Creek, miners assured him that they were able to trace it beyond in a northeast direction by gravels on the surface.

The gravels contain chert, diabasic and metamorphic rocks, vein quartz, and some other pebbles, with also many very large quartzite bowlders. They are exposed on the sides of the valleys of the differ-

ent creeks cutting the bench and have rolled down into the present stream beds where the great number of large quartzite bowlders make considerable trouble for the miner.

The origin of these gravels has been puzzling to the miners and prospectors. Their great width and depth, their position so far above the present gravels of Minook Creek, and the presence of the great quantity of heavy quartzite bowlders, where the bed rock would afford no such material, have made it seem to many miners necessary to assume that some larger stream, possibly the Yukon itself, once flowed across the country. This view received some support from the apparent course of an old channel either toward or from the northeast, while the present stream flows somewhat west of north from the mouth of Hunter Creek.

The data at hand suggest that Minook Creek while flowing toward the Yukon to the northeast of its present course, when the land stood at a lower altitude, had formed a flood plain of approximately the dimensions of the present high bench. With the elevation of the land along the Yukon, the effects of which are to be seen over hundreds of miles, the mouth of Minook Creek may have been raised through local variations, its grade may have been lessened, and the former flood plain may have had the gravels under discussion deposited over it. As the elevation went on, the creek was forced to the west and finally found a new outlet to the Yukon. The elevation continued, and Minook Creek cut downward, leaving its gravels on a bench above it. The elevation did not, perhaps, proceed steadily but periodically, and thus intermediate benches were formed.

The smaller creeks, Hunter, Little Minook, and Hoosier, all give some support to this hypothesis. By reference to the map (Pl. II, p. 60) it will be noticed that each of them, upon reaching the edge of the bench gravels, sharply changes its course and flows westward through the high bench. In the case of Hunter Creek and Little Minook Creek the change in direction amounts to about a right angle, while with Hoosier Creek the angle is less acute but still noticeable. The eastern limit of the bench gravels probably marks the mouths of the various streams when this line represented the course of Minook Creek. As the course of Minook Creek was shifted to the west the tributary creeks followed under the influence of the same force that shifted the larger stream. The age of the bench is probably Pleistocene, as is shown by vertebrate fossils found in the gravels of Little Minook Junior Creek, which seem to be the oldest gravels of the streams cutting the bench.

Gold has been found in the bench at many places, and between Little Minook Creek and Hunter Creek a large amount of prospecting has been done. This portion of the bench is known as "Idaho Bar."

One shaft near the middle of the divide toward their eastern edge is said to have shown the gravels to be over 100 feet thick. Many other prospect holes have been sunk in them at various places, and tunnels were run above Little Minook Creek at their eastern edge. Three claims upon this portion of the bench have been patented. From the bottom of one prospect hole, between Little Minook Junior Creek and Hoosier Creek, $27 was reported to have been taken, but drifting failed to show pay. Above Florida Creek, in the small area of high gravels known as "Macdonald Bar," prospect holes gave colors but no pay. Apparently the gravels of the bench are nowhere rich enough to pay for drifting, although if it were possible to get hydraulic water to them cheaply they might, perhaps, be worked at a profit. The aneroid barometer readings, though not very reliable, suggest the possibility of bringing water from a point 3 or 4 miles above the mouth of Granite Creek under sufficient head to work at least a part of these gravels, if prospecting should show them to be rich enough to warrant the expense.

CREEKS CUTTING THE HIGH BENCH.

Hunter, Little Minook, Little Minook Junior, Hoosier, and Florida creeks cut through the high bench just described. Of these, Little Minook Junior and Florida creeks have their channels in large part or wholly within this area, while, as already noted, the other creeks lie partly outside and change their courses noticeably upon reaching it. The three longer creeks head close together in the hills which extend northward from Wolverine Mountain and divide the Minook drainage from that of Troublesome Creek. Their valleys, even at the heads, are so steep that the trails leading out of them are exceedingly difficult to travel.

Hunter and Hoosier creeks not only have had a sufficiently large flow to cut their canyons, but they did it quickly enough to have since had opportunity to widen them, while Little Minook Creek with its smaller volume has not yet graded its valley sufficiently to do so much side cutting, and Little Minook Junior and Florida creeks lack much of having cut their beds down to grade.

HUNTER CREEK.

General description.—Hunter Creek is the first tributary of any size above the mouth of Minook Creek. It is between 12 and 15 miles long, carries probably a little over 40 second-feet, and flows in a steeply walled canyon-like valley through its whole length. In its upper 7 or 8 miles it flows almost north until it comes to the line of the high bench, when it turns at a right angle and flows west to Minook Creek.

Through the upper part of its course it is a crooked stream with a narrow V-shaped valley, probably indicating a rejuvenated drainage, while at its turn into the high bench the course becomes almost straight, showing a young, rapidly cut valley. It has but one tributary below the bend—Dawson Creek—entering from the south about 4 miles above the Minook. In the lower part of the valley of Hunter Creek the two sides are unlike. On the south side the upper 300 or 400 feet of the valley wall is very steep, almost precipitous. The descent then becomes gentler and forms a broad bench which slopes easily to the creek where it ends abruptly with a face 15 to 40 feet high. This bench is probably to be correlated with the lowest one on Minook Creek. It is covered with gravel, varying in thickness from 5 or 6 feet to 15 feet, and with muck varying in thickness from 1 foot near the creek to 40 feet or more near the hillside.

The creek flows tortuously through its bench, retaining the meanders it had before the bench was formed, and generally is close to the north side of the valley, but occasionally, as about 4 miles above the mouth, it wanders toward the south side, cutting away most of the bench. The valley has a grade in its lower part of 75 to 80 feet per mile.

Gold was discovered in Hunter Creek Valley by William Hunter (for whom the creek is named) in 1896, at a point about 1¼ miles above the mouth. Few definite data were obtainable concerning the gold production of the creek, but it is believed to have been approximately $24,000, of which $3,000 was produced during the winter of 1903–4 and $3,000 during the summer of 1904, a total for the year of $6,000. Hunter Creek has so far not proved to be a rich creek, though gold has been found in the gravels of both the bench and the present stream bed.

At the head of the creek the bed rock is mostly Rampart slate and quartzite; tuffaceous greenstones which predominate in the lower part of the valley are overlain near the mouth by Kenai sandstones and conglomerates. The tuffs contain some rounded pebbles, and a hole 228 feet deep was sunk in them under the impression that they belonged to the frozen muck and gravels of the creek. The rocks are much jointed and contain many small veins of quartz and calcite. Pyrite occurs at many places.

The gravels of the creek are 2 to 12 feet thick and are mostly diabase, slate, and chert pebbles from the bed rock, with many heavy bowlders of quartzite, occasionally reaching 3 feet in diameter. These larger bowlders are residuals from the gravels of the old bench through which the valley is cut. Much of the diabase gravel is angular or subangular. The muck over the gravel varies in thickness from 1 foot in places along the stream to 40 feet or more where the small streams pour their débris upon the valley floor.

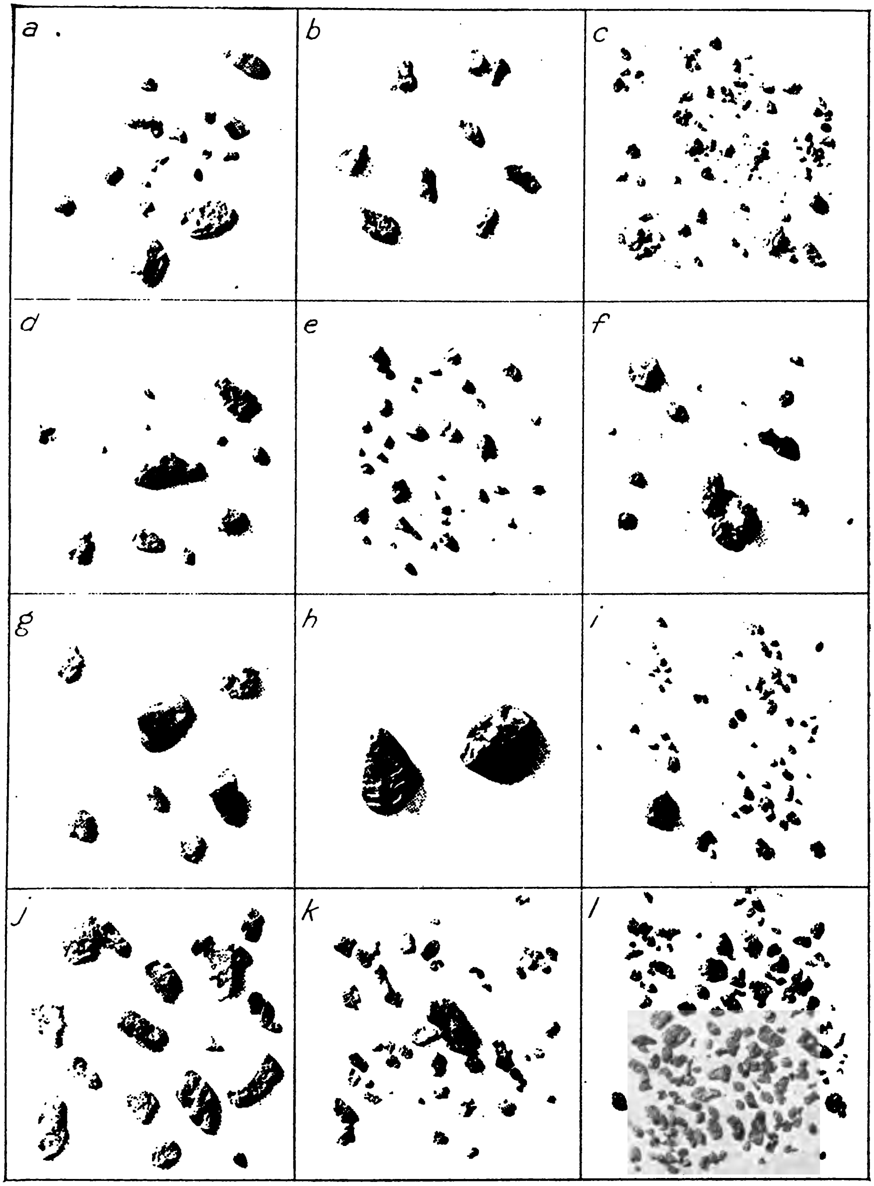
Mining.—During the summer of 1904 work was being done on Discovery claim, about 1½ miles above the mouth of the creek; and on No. 17, a claim about 4 miles above the mouth. Several claims between these were being prospected.

On Discovery claim a flume 2,000 feet long, 30 inches wide, and 20 inches deep carried water to a bench about 16 feet above the creek. The bench was covered by 5 to 6 feet of gravel and over this was 1 to 4 feet of muck. The muck and gravel were practically all sluiced off, and the loose bed rock, in which the gold is found to a depth of about 18 inches, was shoveled into sluice boxes. The bed rock is partly a diabase and partly a much-folded brown, cherty shale standing on edge. The large bowlders were moved by hand. Three men ground sluiced an area 75 by 150 feet in thirty days. The gold is mostly bright, smooth "pumpkin seed," with a few small rough pieces (Pl. III). A considerable amount of small barite pebbles and some hematite occur in the concentrates.

On claim No. 17-A a hydraulic plant was installed during the season of 1904. About a mile of combined ditch and flume had been put in, about 3,000 feet of which was flume, 32 by 18 inches, delivering 300 inches of water under a head of about 75 feet. A No. 1 Hendy Giant with a 3-inch nozzle was being used.

In working the ground the niggerheads and moss are torn up with a team and harrow and washed off with the nozzle. The ground is then left for a week, during which time the muck will thaw 1 to 2 feet. This is then washed off. The process is repeated until the top is removed. The remaining gravel thaws much more rapidly than the muck. It is found that the gravel can thus be thawed and made ready for sluicing much faster than a hydraulic giant working steadily can wash the gravel into the sluice boxes. In one instance an area of 125 by 250 feet was worked out in 40 days. The gravels are 2 to 12 feet thick, averaging about 6 feet, and are covered by 1 to 40 feet of muck. The maximum thickness was found at the mouth of a small tributary gulch where the gravel is mixed with angular fragments of rock. The muck contains much ground ice, which thaws readily when hydraulicked. The ice occurs occasionally as "dikes." One such was encountered over 400 feet long and 2 feet thick, intersecting the surface layer of muck and a flat lenticular mass of ground ice down to the gravel, making a depth of 12 to 15 feet.

The gold is found through the lower 3 feet of gravel and in the rough broken bed rock, which is made up of diabase and thin-bedded quartzite. It is bright and smooth, and nuggets up to 10 ounces in weight have been found. There is a small amount of rougher gold. Colors of gold are said to occur throughout the length of the creek, but no workable deposits have been found above the eastern limit of old gravels on the high bench already described. The larger part



GOLD SPECIMENS FROM THE RAMPART REGION.

a. Gold from Discovery claim, Hunter Creek.
b. Native silver from Claim No. 10 above, Slate Creek.
c. Gold from Shirley Bar.
d. Gold from Claim No. 1 above, Thanksgiving Creek.
e. Gold from Claim No. 3 above, Thanksgiving Creek.
f. Gold from Claim No. 11 above, Omega Creek.
g. Gold from Seattle Bar.
h. Gold from Discovery claim, Doric Creek.
i. Gold from What Cheer Bar.
j. Gold from Claim No. 8 above, Little Minook Creek.
k. Gold from Claim No. 3 below, Little Minook Creek.
l. Gold from Claim No. 4 below, Little Minook Creek.

All the specimens are natural size.

of the gold has probably been reconcentrated from this bench. The smaller portion of rough gold has probably a local source in the rocks of the creek valley. Drifting is done in the winter at a number of places on the creek, but little information could be obtained as to results.

LITTLE MINOOK CREEK.

General description.—Little Minook Creek empties into Minook Creek about 5 miles from the Yukon and about 1½ miles above the mouth of Hunter Creek, and has so far been the largest producer of the region. In drier years it carries scarcely a sluice head of water. It has a grade of 100 feet or less per mile in the lower 3-mile section to which all the mining has been confined, and its course is remarkable in being nearly parallel to Hunter Creek, though considerably shorter, as it has a length of only about 8 miles. Like Hunter Creek it makes a sharp bend upon entering the high bench about 3 miles from Minook Creek. Above this bend Little Minook Creek has a maturer character, as shown by the more crooked valley and greater number of tributaries, while in its course through the bench it has a straight sharply V-shaped valley which has been cut to a depth of 500 to 700 feet, and is so narrow that for over three months of the winter the sun can not be seen from the bottom of the valley.[a]

The creek follows closely the southern side of the valley through its lower 3 miles, and mostly the western side above this. It seems likely that the greater accumulation of talus on the north side of the creek is due to the greater amount of sunshine it receives, resulting in a greater amount of breaking down of bed rock by alternate freezing and thawing.

Gold was first discovered upon the creek in the early nineties by John Minook, who is reported to have taken out some gold near the mouth of the creek. The first claim, however, was located and worked by F. S. Langford in 1896, since which time the creek has been worked continuously. The total production of the creek is calculated, from the best ascertainable figures, to be $486,100, of which $40,000 was taken out during the winter of 1903–4 and $2,900 during the summer of 1904, making the output for the season of 1904 $42,900.

Little Minook Creek heads among slates and quartzites cut by small decomposed acid dikes. A little over a mile below the head, the creek is crossed by a belt of clayey, nonfossiliferous limestone, accompanied, as is often the case with the Rampart rocks, by green fine-grained slates. Below this there is an indistinct series of interbedded quartzites, cherts, siliceous shales, and some sandstones, all greatly contorted and accompanied by large masses of greenstones which form probably the larger part of the bed rock of the lower valley. At the foot of the

[a] Peck, C. W., and Laboskie, Wallie, personal communication.

valley walls the exposure of igneous rocks seems to be greater than in their upper parts; that is, erosion seems to have exposed larger masses of igneous rocks. Small veins of quartz and calcite occur in the rocks, but none of great extent. The rocks of the valley have a considerable impregnation of iron pyrites, the oxidation of which has stained them the familiar rusty brown of iron oxide.

The placer deposits are all in the stream bed. The valley has been cut down so quickly that no bench deposits have formed. The alluvial deposits of Little Minook Creek vary in thickness from 7 to 25 feet, of which gravel forms 3 to 12 feet, and muck, though occasionally absent, generally 3 to 16 feet. The deposits are shallowest in the lower part of the creek. The gravels contain fragments of many rocks, of which diabase is probably most abundant, but slate, grit, and much vein quartz also occur, and there are many large quartzite bowlders from the bench above. Much of the gravel, as would be expected in a weak stream, is subangular.

In the gravels mammalian bones are said to be found, although none were seen by the writer. In places clear ice is uncovered in digging, the structure of the alluvium showing how sudden floods had drifted detritus over the ice in the spring, and had thus preserved it. Locally there is much wood in the muck.

Occurrence and character of the gold.—Values are found in the lower part of the gravels through a thickness of 1 to 3 feet, and a width of 50 to 200 feet. The gold frequently occurs in the bed rock, particularly the broken diabase, to a depth of 1 to 2 feet. The pay streaks extend up the creek only as far as the creek has cut through the high bench gravels, a distance of about 3 miles. There are sixteen 1,000-foot claims within these limits.

The creek has been well prospected throughout its length, and although colors are found there is no pay above the line of the high bench. A small amount of gold, in which were some large nuggets, has been found in the gulches leading from the high bench. The amount of gold carried by the gravels varies greatly, but in the pay streak probably runs from $2 to $10 per square yard. The gold is generally smooth, chunky, and bright (Pl. III, j, k), and shows a large amount of wear. In the upper part many nuggets are found weighing 1 to 12 ounces apiece, but the gold gets finer downstream until near the mouth it is nearly all flat, smooth, bright, and even in size, looking like golden bran when seen in quantity. There is a very small amount of rough gold, probably of local origin, but the larger part is probably reconcentrated from the old bench gravels of Minook Creek. The gold of the creeks cutting this bench is said to assay over $19 per ounce. This would make it of about the same value per ounce as the Koyukuk gold. The gold is taken in trade by the stores

at $18 per ounce. Some small nuggets of copper and a small amount of silver have been found with the gold.

Mining.—Most of the claims are worked by drifting in the winter, though the three lower ones are worked during the summer by open cuts. On the latter the muck and gravel are first ground-sluiced off within 1 or 2 feet of bed rock by means of a dam provided with an automatic gate, and the remaining gravels are afterwards shoveled into the sluice boxes. The drifted pay gravels have often been "coyoted" or "gophered;" that is, holes have been sunk here and there without system until, although there is probably much pay still left, the ground is frequently almost unworkable on account of the ice in the old holes which floods the new workings when thawed by a steam point. When workings are filled with water, the mass is said to freeze on the top, sides, and bottom, while the central part remains unfrozen through several years. Much of the ground is worked on "lays" or leases, the lessees paying from 25 to 55 per cent of the gross output, an amount that is apt to leave the worker little for his labor if things do not run very smoothly. Freight rates are 2 cents per pound in winter and 4 cents per pound in summer.

The remaining gold in Little Minook Creek would seem to be best recovered by working the claims in cooperation as one company, for it is certain that some of the richer claims can no longer be profitably worked by drifting. The quickest, but an initially expensive, mode of working would be to hydraulic the gravels by bringing water from Minook Creek. A ditch 10 miles in length above the mouth of Little Minook Creek would probably give a head of over 100 feet and plenty of water at the upper limit of the pay gravels. A way requiring less capital, but much slower, and the one that will likely be carried out in the end, is the ground-sluicing of the claims, successively, from the mouth of the creek upward, by means of dams and automatic gates, but as the claims belong to different parties, some of whom are unwilling to sell, there will probably be only a small amount of work carried on along the creek for a number of years to come.

LITTLE MINOOK JUNIOR CREEK.

General description.—Little Minook Junior Creek, between Little Minook and Hoosier creeks, is about 2½ miles long. Its valley lies wholly within the high bench of Minook Creek. It is a weak stream, generally dry during the summer, and rarely carries a sluice head of water. With a valley of hard rocks it has not been able to cut its bed down to the depth reached by the larger tributaries of Minook Creek. In the lower half the grade of the creek is torrential and the valley is narrow with steep sides. In the upper half the grade is

much easier and the valley is wider with gentler slopes, especially on the north side. The rocks of the valley are the same as along Little Minook Creek. The lower part is entirely in diabase.

The total output of the creek was estimated by Donald McLean at about $150,000, and the output for the year 1904 at about $17,000.

The steep grade of the lower part of the creek has allowed little accumulation of alluvium, but in the upper part the deposits have reached a depth of 12 to 30 feet, of which gravel forms the lower 4 or 6 feet. The gravels are angular and largely composed of diabase with well-washed quartzite bowlders from the bench gravels through which the stream has cut.

In the gravels are many bones of bison, musk ox, mammoth, and horse. A very fine specimen of the skull of *Bison alleni*, with the shell upon the horns, was taken out of Donald McLean's claim, No. 25, near the head of the creek, by Mr. McLean and Thomas Evans. This is the only specimen of this species that has been reported from Alaska. It was carefully removed and is now in the National Museum at Washington. Some teeth obtained by C. W. Peck from gravel next to bed rock on the same claim and referred to Dr. T. W. Stanton for identification were called by him "horse teeth of Pleistocene or more recent age."

Mining.—There are 29 500-foot claims upon the creek, numbered from the mouth upward, the upper 9 or 10 of which are said to have paid wages or more upon working. The pay streak is 30 to 60 feet wide and 1 to 6 feet thick, averaging probably 3 feet, but gold is sometimes found through the whole thickness of the gravel. The gravels were reported to carry $10 per square yard on one claim, which is probably the highest value on the creek, the values on other claims running down to amounts too small to pay for working.

The gold is similar to that of Little Minook Creek, mostly smooth and bright with a little that is rough. It is generally coarse and chunky, nuggets sometimes reaching 3 ounces in weight. The larger part of the gold is undoubtedly reconcentrated from the high bench of Minook Creek. The small amount of rough gold has probably had its origin in the bed rock.

The gravels have been mined by drifting with steam points, but advantage was taken of the wet season of 1904 and some ground sluicing was done in gravel and muck 16 feet thick. Trees and brush in the lower part of the creek were cleared away in preparation for further ground sluicing. The cost of mining by drifting is 50 per cent or more of the output, but as there is so little water it has been the only feasible mode of work. The creek is considered to be nearly worked out.

HOOSIER CREEK.

Hoosier Creek flows into Minook Creek from the east side between 5 and 6 miles from the Yukon. It is a stream of about the same volume as Hunter Creek and has a valley of about the same gradient and general section, but it shows no sign of the bench that appears along Hunter Creek. Like Hunter and Little Minook creeks, its course bends to the left upon entering the area of the high bench of Minook Creek, although in a less degree.

The production of Hoosier Creek is unknown. There is assigned to it but $500 in a previous report, $227 of which was in one nugget. Other small amounts have been taken out, but the production has not been large, and it has been almost impossible to thoroughly prospect the creek on account of live water in the gravels.

The bed rock is similar to that of the other creeks cutting the bench. Quartz veins up to 18 inches in width occur in the diabase, and there is some pyrite distributed through the rocks. The alluvial deposits vary in thickness from 6 to 15 feet, of which 1 to 9 feet is gravel, averaging probably about 6 feet, and 1 to 10 feet is muck, averaging perhaps 6 or 7 feet. There is thought to be a pay streak about 100 feet wide whose length coincides with the distance the creek flows through the high bench, but the gravels of the valley are broader than those of the other creeks described, and with the live water the pay is hard to locate.

Two miles above the mouth of the creek a hydraulic plant has been installed and had just gotten in shape to begin work at the end of the season of 1904. A combined ditch and flume 4,300 feet in length delivered 500 miner's inches of water under a head of about 80 feet. A hydraulic elevator is used to dispose of the tailings.

FLORIDA CREEK.

Florida Creek is only about 2 miles long, lying in the high bench of Minook Creek about 2 miles south of Hoosier Creek. Ordinarily it is dry during the summer and fall. The gradient of the stream is high and the valley narrow. The bed rock is almost entirely of diabase. The alluvial deposits are narrow, but in places reach a depth of 15 or 20 feet. Nuggets up to $33 in value have been taken from the creek, but so far as known not more than a total of $2,000 has been obtained, though the stream has been well prospected. The first prospect showed up so well that miners at once located the whole of the creek, and a number of good cabins were erected on the different claims. Some ground sluicing was done on the lower part of the creek during the season of 1904, but no other work was done.

ORIGIN OF THE GOLD.

The great difference in the richness of the several creeks flowing through the high bench of Minook Creek, and the variation in the richness of claims and size of nuggets on the same creek within the limits of the bench, show that the gold is not evenly distributed through the gravels of the bench. Thus Hunter Creek has so far shown no rich claims, while Little Minook Creek has been very rich in places, and along the latter the gold is very coarse on the upper claims but grows much finer toward the mouth (Pl. III, j, k, and l), showing that probably the larger part of the gold in the lower portions of the stream has been washed down from the upper claims. The gold in the bench gravels was probably concentrated from local gold-bearing zones in the rocks worn away above the level of the high bench. How great a thickness of these rocks was disintegrated and carried away can not be told, but there may have been many hundred feet. The rocks were probably the same as those now forming the bed rock. The gold in the bench gravels is said to be well worn, but gold found in the gravels of a stream as large as Minook Creek is generally well worn, and in this case we have no clue as to the length of time through which wearing may have continued.

OTHER TRIBUTARIES OF MINOOK CREEK.

RUBY CREEK.

Ruby Creek flows into Minook from the west side about 9 miles from the Yukon. It is a stream carrying 300 to 500 miners' inches (7.5 to 12.5 second-feet) of water, with a grade of about 150 feet per mile in the lower part. In this part the valley is broadly V-shaped, with steeply sloping sides. The upper part was not seen.

The first pay was taken out of the creek in 1901, and the total product is said to have been $13,000 or $14,000, although this estimate may be a little high. About $5,000 was reported during 1904. No pay has been found above 1½ miles from the mouth of the creek, but it is claimed that no holes have been sunk to bed rock on account of the live water in the gravel.

The bed rock is the calcareous schist, garnetiferous mica-schist, carbonaceous slate, chert, and grit, intruded by greenstones (diabase?). The bedded rocks strike almost north and south across the creek with the dip downstream (east). The alluvial deposits are 6 to 10 feet thick and 300 to 500 feet wide. In some places there is almost no muck and nowhere is its depth more than about 4 feet. The gravels are 5 to 7 feet in thickness and the total thickness of muck and gravel is 6 to 10 feet, averaging nearer the lower figure. No large chert or

quartzite bowlders are seen, as in the creeks, cutting the high bench. There are some gneiss pebbles, which indicate the probable presence of gneiss on the creek. The gravel is comparatively fine but contains a few bowlders a foot or more in diameter.

The gold is all on bed rock and is distributed through the whole width of the gravels. The only gold seen came from a point about one-half mile above Minook Creek. It was somewhat iron stained and in general rougher than the gold of the creeks cutting the high bench. The larger pieces were very smooth, but the smaller pieces were rough and most of the gold is rather flat. The gold is said to be rougher in the claims below. Nuggets up to about 2 ounces in weight are obtained. In the concentrates with the gold are large quantities of garnets that sometimes reach 1 inch in diameter. A handful of garnets was obtained from a pan of dirt. There are so many of them that they give considerable trouble by filling up the spaces in the riffles and must be cleaned out once or twice a day. Some barite is said to be present, and an occasional silver nugget appears, one weighing 2 ounces having been reported. The silver nuggets are very rough.

It seems likely that the origin of the gold is in the local bed rock, which along this part of the creek is a carbonaceous slate of irregular cleavage. In places much pyrite is distributed through it. The creek has been worked during the summer by open cuts and in winter by drifting, but it has probably paid little, if anything, more than wages. Preparations were being made to install a hydraulic plant, and a mile of steel pipe, consisting of 720 feet each of 20, 19, 18, 17, 16, 15, and 14 inch pipe with branches of 11-inch pipe for an elevator, and 7-inch pipe for a giant, was to be put in. It was said that it would deliver the water under a head of 154 feet.

SLATE CREEK.

Slate Creek, a western tributary of Minook Creek, about 12 miles from Yukon River, is about 4 miles long and is said to always carry at least a sluice head of water. It has a grade in the lower portion of about 150 feet to the mile, and the valley is narrowly V-shaped.

The creek has been worked only since 1902. Freights from Rampart are 8 cents per pound in summer and 4 cents per pound in winter.

The bed rock in the lower part is much-folded shaly limestone, green and purple slates, and cherty beds, with a northeast strike. The main rock of the valley is a dark carbonaceous schist which breaks into pencil-like fragments and contains many quartz seams. Most of the work has been done nearly 2 miles above the mouth by drifting in the winter. The deposits here are 26 feet thick.

Gold is found in as much as 3 feet of gravel and to a depth of 1½ feet in bed rock and over a width of 50 feet. An $8 piece is the coarsest thus far taken out. Silver is a common associate (Pl. III, b), and an 8-ounce nugget has been found. Copper is also said to occur in the gravels. The absence of garnets indicates that the schists of Ruby Creek do not extend into the valley. The gold in this case has probably been derived from the small stringers common in the bed rock.

THE BAKER CREEK GROUP.

GENERAL DESCRIPTION.

The Baker Creek diggings are situated from 28 to 32 miles by trail almost south from Rampart, and occupy a narrow belt with a northeast-southwest extension of about 9 miles. Along Baker Creek itself there have been no placers discovered so far, all at present known being on the tributaries flowing from the divide separating the Minook and Troublesome drainages from that of Baker Creek. The principal diggings are located along Pioneer, Eureka, Glenn, Gold Run, Omega, and Thanksgiving creeks.

The topography is strikingly different from that of the other two areas. Baker Creek flows along the southwestern side of a large flat, 7 to 9 miles broad in its widest part, and perhaps 10 miles long, its longer extension being northeast-southwest in the line of flow of Eureka and Hutlina creeks. Instead of sharp canyon-like valleys the streams flow through open valleys, and where they flow in general parallel to the Baker-Minook divide—that is, approaching a northeast-southwest or an east-west direction—the southern bank is steep, while the northern one is gently sloping, the creeks flowing close to the steeper side. Even along the broad Baker Flats this feature is still prominent. The north side is a long gentle slope toward the divide, rising more sharply in its upper part, while across the flats the southern side may be seen rising abruptly from the valley floor.

The main streams of the Baker Creek gold area are: Eureka Creek, lying next to the Baker-Minook divide, flowing southwesterly for about 5 miles, then turning to the south; Pioneer Creek, flowing parallel to Eureka between 1 and 2 miles to the southeast and joining it on Baker Flats; Rhode Island Creek, flowing in a southerly direction, about 1½ miles west of Eureka Creek; and Omega Creek, in the western part of the gold area. Into these creeks flow all of the smaller creeks of the area along the Baker-Minook divide. The streams are all small, many of the smaller ones being ordinarily dry during the summer and fall. The gradient of the larger streams is comparatively low and it is with difficulty that water is carried to the benches.

The only practical trail to and from the Baker Creek area is from Rampart along Minook Creek, a trail that in most parts of "the States" would be considered practically impassable during the summer time. Most of the way it is soft and miry. The pack horses sometimes sink to their girths, floundering and wallowing their way through. As a choice, there is the bed of Minook Creek along which, if the creek is not too high, the horses can make their way on the bars and through the icy water; but at best this trail is hard on the animals. The foot traveler can not take the creek bed, and if he carries a pack, as he often does, he must make his way along the mucky trail. Over this trail all provisions for the camps are carried. Freight rates, until the summer of 1904, were 25 cents a pound in summer and 6 cents in winter, and it is said that one man had to pay freight on 47 pounds of "grub" and 53 pounds of box and packing at the higher rate. During the summer of 1904 freight rates came down to 15 cents a pound, but the packers declared they could make nothing at that rate, and this is probably true, as hay and oats when cheapest are $100 a ton. There is another trail to the mouth of Baker Creek, but it is said to be bad and is not used.[a]

Lumber is high, most of it being shipped from the States of the Pacific slope. Some is whip-sawed along Baker Creek in the winter, which costs about 20 cents a foot, board measure. It would seem that a small sawmill operated through a portion of the year would be a paying investment, as there is said to be plenty of timber along Baker Creek for local needs.

The total production of the region is estimated to have been about $406,100, of which $84,700 was produced during the winter of 1903–4 and $61,300 during the summer of 1904. These figures are probably under rather than over the actual amount.

Gold was discovered in the Baker Creek area on Eureka Creek, where mining was begun during the winter of 1898–99 and a small amount was taken out. On Glenn Creek gold was discovered in July, 1901, on the benches along Pioneer Creek in 1902, on Thanksgiving Creek in February, 1903, and other discoveries were made during the summer of 1904. Prospecting is in active progress in other valleys of the vicinity, and it is altogether possible that new discoveries may be made.

The rocks of the Baker Creek group show less variety than those of the Minook Creek group. In the gold-bearing region the rocks are schistose grits with interbedded slates and with quartzites, the latter in thin strata, generally 1 to 3 feet thick. Both slates and schistose beds are generally carbonaceous. The strike is northwest and the dip about vertical. No igneous rocks occur except along the top of

[a] During 1907 and 1908 a wagon road was being built by the Government from Rampart up the Minook Valley to connect with the Baker Creek region.

the divide, where there are some dikes and masses of a monzonitic rock. Quartz occurs generally only in small veins, and these are not prominent. In places there is a considerable amount of pyrite in the rocks in small crystals and grains, but no large masses or veins have been seen.

THE CREEKS AND BENCHES.

EUREKA CREEK.

General description.—Eureka Creek, on which gold was first discovered in this area (in February, 1899), flows southwestward along the foot of the Baker-Minook divide. It runs in a straight southwest course for about 4½ miles, then turns and runs south 2½ miles to its junction with Pioneer Creek. It has a number of small tributaries from the northwest side, but none from the southeast. The largest is Boston Creek, about 2 miles long, which joins Eureka Creek at its bend. The other tributaries are mere rills. Eureka is a small creek carrying barely a sluice head of water above the mouth of Boston Creek during the ordinary seasons. From aneroid barometer readings the gradient of the stream is about 100 feet per mile. The valley slopes gently to the divide on the northwest side, but on the southeast side the slope is almost precipitous, rising 400 to 600 feet above the valley. The creek flows close to the foot of the steeper side.

The gravels of the creek are not much worn, as is characteristic in weak streams, and have been left for a considerable distance, in places at least 500 feet, up the slope of the hill as the stream bed has moved to the southeast. The bench gravels, like those of the present stream bed, are made up entirely of the country rocks. The deposit varies in thickness from 5 to 18 feet, and the overlying muck varies from nothing to 8 feet, the distribution being rather irregular. The total thickness varies from 5 to 20 feet. The gravel contains a considerable amount of very sticky clay, which makes sluicing difficult. The clay seems to come from the decomposition of both the grit and the slates.

Mining.—Only one claim above and one below the mouth of Boston Creek have so far been made to pay, but prospectors on the bench gravels about 2 miles above the mouth of Boston Creek reported that they had found gold in sufficient quantities to pay for ground sluicing, if not for drifting. On this part of the bench it is 8 feet to bed rock near the creek, and 450 or 500 feet back from the stream it is 20 feet. The elevation above the creek at this distance, as shown by the aneroid barometer, is 70 feet.

The gold is said to be in the lower 18 inches of gravel and in a foot of bed rock. Along the creek the bed rock is largely blocky, and in it gold is found to a depth of 3 feet; but it is not found at such depths

where the bed rock decomposes into clay. The gold may be distributed through the gravels to a depth of 4 or 5 feet, but it is generally close to bed rock, which must be scraped.

The larger part of the mining has been done by drifting, but on Discovery claim, just below the mouth of Boston Creek, an open cut is being worked. The muck and upper gravel are ground sluiced through sluice boxes, so as to save any fine gold that may be in them, and the lower gravel is shoveled in. Fifty-seven 12-foot boxes are used, 37 of which contain pole riffles and 2 contain Hungarian riffles. The lower boxes are lined with sheet iron to facilitate the movement of the gravel. Some gold is probably carried off by the sticky clay in spite of the length of the sluice box.

PIONEER CREEK.

General description.—Pioneer Creek heads against the Baker-Minook divide, flows around the head of the Eureka, and then, at a distance of 1 to 2 miles, flows parallel to the main course of that creek. After traversing 7 or 8 miles it joins Eureka Creek and they are said to lose themselves on Baker Flats. Pioneer Creek is larger than Eureka Creek; probably it never carries less than three or four sluice heads of water, and its gradient along its lower course is about 60 feet per mile. The valley is similar to that of Eureka Creek. Its northwest side is a gentle slope running back for about a mile, and the southeast side is of almost precipitous steepness, but not so high.

On the gentle slope of the northwest side there are perceptibly flatter places or benches, but only one of these is persistent. This bench is traceable along Pioneer Creek for over 4 miles. Its northeast end is but little above the present level of the creek while its southwest end is about 250 feet above the creek. Over this bench and covering much of the slope below is a deposit of auriferous gravel left by the creek as it moved to the southeast. The different diggings upon it are known as "bars."

Five small tributaries, Doric, Boothby, Seattle Junior, Skookum, and Joe Bush, flow across this bench at right angles to the course of Pioneer Creek. Near the upper end of the bench at Joe Bush Creek prospect holes showed a well-defined old stream channel. Upstream the bench rises so that a ditch supplying water to What Cheer Bar is below the workings at Seattle Bar, but crosses the bench and is on the upper side when it reaches What Cheer Bar. There can be no doubt that the bench is of stream origin.

Like many other Alaskan creeks Pioneer Creek was staked and then each man waited for his neighbor to do the hard work necessary to locate the pay streak, if there was one. Meanwhile the claims lapsed and were then restaked by other parties, and pay was discov-

ered on What Cheer Bar in 1902. After this discovery pay was found on Doric Creek and at several other points along the bench.

The production of Pioneer Creek Valley to the end of the summer of 1904 was about $35,800.

The bed rock is the same as on Eureka Creek, schistose grit, with interbedded slates and thin beds of quartzite. The grits sometimes become very carbonaceous, particularly on Doric Creek. The general strike of the rocks is N. 70° or 75° E., with a steep northerly dip. There is some quartz in small veins and stringers, and on Doric Creek at places there is considerable pyrite distributed through the rocks. The pyrite is often oxidized, so that only small holes lined with iron rust indicate its former presence. On Doric Creek inclusions of a carbonaceous substance the size of a walnut occur with small quartz seams. Little is known of the alluvial deposits along the creek bed. The deposits on the gentle slope already referred to are 3 to 12 feet thick. They consist of the usual muck and gravel, and extend over 2,000 feet back from the creek.

What Cheer Bar.—What Cheer Bar is located in the lower part of Pioneer Creek Valley, about a mile from Eureka Creek, 2,000 feet from Pioneer Creek, and 250 feet above the latter. The season of 1903 was spent in putting in about 4 miles of ditch, with the necessary flumes. This ditch carries about three sluice heads of water to the upper edge of the workings. The ground is excellent for ditching, compared with other Alaska localities, for there is little ground ice and the soil is tenacious enough to make good banks. The bed rock is much jointed and broken and exhibits fine examples of creep, the rock leaning downhill and gradually blending with the gravels.

The average depth to bed rock is about 12 feet. The overlying material is composed of 1 to 1½ feet of muck, 3 feet of rather fine flat wash, 5 feet of medium-sized yellowish gravel, and 3 to 4 feet of rather heavy wash, including some bowlders of vein quartz 2 feet or more in diameter. There are some bowlders of conglomerate similar to that found in Quail Creek, in Troublesome Valley, and it is probable that beds of it outcrop on the headwaters of Pioneer Creek. Most of the gold is found in the lower part of the gravels and the upper 1 or 2 feet of bed rock. It is well worn and bright (Pl. III, i), and probably is derived from the bed rock in the vicinity. The largest nugget found weighed somewhat less than 2 ounces and was worth $28. It contained considerable quartz. The gold is taken in trade at $15.50 per ounce.

The muck and upper gravel are ground sluiced and the lower gravel and upper bed rock shoveled in. The water could not be used until August 15, and only fifteen days were available for washing. Fifteen men were employed.

Seattle Bar.—Seattle Bar is about 2½ miles farther northeast on the same bench, on the northeast side of Seattle Junior Creek, and about the same distance back from Pioneer Creek as What Cheer Bar. Pay was discovered here in the spring of 1904. The depth to bed rock is about 9 feet and the bed rock and gravel are similar to those of What Cheer Bar. The gold occurs in the lower foot of gravel and the upper foot or more of bed rock. It is bright, chunky, and well worn. Some of it is rather flat, but all is easily saved. The largest nugget obtained was worth $9.40. Water is obtained for sluicing by a ditch and hose from Skookum Creek, which in a dry year will furnish but a scant supply.

Doric Creek.—Doric Creek is a small tributary of Pioneer Creek about three-fourths mile above What Cheer Bar, and is dry most of the summer and fall. It has an open valley, at its greatest depth probably not over 50 feet below the level of the bench. Gold was discovered here in 1902, and in the winter of 1903–4 a portion of the valley about one-fourth mile from Pioneer Creek was found to be very rich. As with other weak streams its wash shows almost no wear, but there is also a large amount of more rounded gravel from the bench through which it has cut.

Only one claim has produced much gold. Some pay was found on the lower part of the next claim above, but none in the upper part. The richness of the deposit is probably due to the reconcentration of the gold from the gravels of the bench. The ground is worked by drifting during the winter, and the largest bowlders are left in the drifts. It is worthy of note that a large degree of the success obtained in locating this claim was attributed to the remarks upon concentration in the Survey report on the Nome region,[a] which apply with much force to many of the deposits of the Rampart region.

Other bench gravels.—A mantle of gravels similar to that which covers the gentle slope on the northwest side of Pioneer Creek bends around a spur from the divide on the west side of Eureka Creek and continues to Omega Creek, a distance of about 2½ miles. Beyond this point it has not been traced. In the space described the gravels are cut by Glenn Creek, Gold Run, Rhode Island Creek, and Seattle Creek.

SHIRLEY BAR.

The bench gravels have been prospected at many places and shown to carry gold, but at only one point outside of the creeks crossing them have they proved sufficiently rich to pay for working. This place, known as Shirley Bar, is located between Glenn Creek and Gold Run. It is at an elevation of about 200 feet above the lower workings on

[a] Brooks, A. H., and others, Reconnaissances in the Cape Nome and Norton Bay regions, Alaska, in 1900; a special publication of U. S. Geol. Survey, 1901, pp. 149–151.

Glenn Creek, and was first worked in the fall of 1901. The bed rock is the same schistose grit, slate, and quartzite. The wash is small and subangular, with a few quartzite bowlders and some monzonitic rocks from the divide above. The gravel varies in thickness from 2 feet at the lower side of the claim to 7 or 9 feet in the middle and 5 feet at the upper end. The gold is bright, rounded, and "shotty," well distributed through the gravel, and, though it seems strange, the nuggets come from near the surface. There are few large pieces of gold, the largest nugget taken out weighing a little over 1¼ ounces.

A ditch from Rhode Island Creek, 1 mile long and capable of carrying 2 sluice heads of water (about 100 miner's inches), has been dug; but water is so scarce that it is collected in a pool after being used and pumped back to the sluice boxes. For this purpose a 30-horsepower boiler, two twinned 4-horsepower upright engines, and a 4-inch centrifugal pump are used. Seven men have been employed on the claim during the season.

GLENN CREEK.

General description.—Glenn Creek is located about 1 mile west of Eureka Creek, and flows across the bench gravels. It is about 3 miles long, running almost south down the slope from the Baker-Minook divide. The valley is shallow and open and probably stands not more than 50 feet below the bench. It is practically dry during ordinary summers, but during the wet summer of 1904 it carried water sufficient for sluicing.

Gold was discovered on Glenn Creek by Messrs. Beardsley, Belsea, and Dillon in July, 1901. The total production up to the fall of 1904, according to the most reliable information obtainable, had been about $277,500, not including the output of one claim known to have produced a considerable amount. During the year ending with the fall of 1904 $50,500 is known to have been produced, and this again does not include some smaller outputs. Of the 1904 output $11,000 was obtained by drifting during the winter of 1903–4 and $39,500 during the summer of 1904.

The bed rock is similar to that on the other creeks. The alluvial deposits are 7 to 9 feet thick and are in large part composed of the angular fragments usually found in so weak a stream, with rounded material from the bench through which it flows. There are occasional small bowlders of monzonitic rock from the divide above.

The quartzite interbedded in the softer slates has given rise to a peculiar condition in the gravels of the lower part of the creek. On claim No. 1A a section of the gravels shows about a foot of muck, under which is a discontinuous layer of angular quartzite blocks 8 to 10 inches thick and 2 feet or more broad, showing no water wearing. Under these is a thickness of about 2 feet of washed gravel, and fine

broken slate lies below this upon vertical strata of slate which strike about northeast. These angular blocks of quartzite on top of the gravel have been very puzzling. It is likely that they are to be explained by the supposition that the creep, which acts very strongly here, has broken down a thin bed of quartzite that can be seen on the side of the claim, and as the creep has moved the gravels the blocks of quartzite have been broken off and have crept with the gravels.

Mining.—The pay seems to have been mostly, if not wholly, in that part of the creek which cuts the mantle of gravel covering the hillside. The pay streak is said to vary in width from 50 to 100 feet. In places it was very rich; one pan taken by the writer gave about \$3.75. Many pans of \$10 and upward were said to have been taken. At one place fine gold could be seen all through the broken slate. On this claim the pay was in the lower 3 feet of gravel and 2 feet of the bed rock. A plat 20 by 48 feet yielded \$4,000 to 4 men working three and one-half days.

The gold is bright, clean, generally worn, and fine, but "shotty" and easily saved. Such nuggets as are found generally contain considerable quartz. The largest nugget found weighed nearly 6 ounces. It was bright, clean, beautiful gold, and showed the impression of large quartz crystals. It is said to assay a little over \$16 per ounce.

A small ditch 1 mile long brings about a sluice head of water from Rhode Island Creek. Another ditch dug to bring a sluice head or more from Boston Creek was just ready to use when freezing began in the fall of 1904. An average number of 24 men are said to have been employed during the year. Some drifting is to be done this winter (1904–5), but it is said that most of the ground fit for drifting has been worked out, the remaining pay gravels being too shallow to give a good roof. The creek is probably more than half worked out.

GOLD RUN.

A creek, about 1½ miles long, flowing into Rhode Island Creek 1 mile west of Glenn Creek, is called Gold Run. It carries little water at any time and is practically dry during the summer and fall. The valley is shallow and open and the lower part is cut through the gold-bearing gravels covering the extension of What Cheer Bar. The creek was staked in the spring of 1899 and the first work was done during the winter of 1900–1901. There are six claims, each 500 or 1,000 feet in length, upon the creek, but only the lower four have so far been producers. The total production during the winter of 1903–4, as reported by the miners, was about \$16,000, not including the output of one claim, which was probably small. The production of former years is estimated at about \$9,000.

The bed rock of the lower part of the creek is a carbonaceous schistose grit, which in places becomes slaty. The rather well-rounded gravels are of slate, quartzite, and grit, 16 to 18 feet deep, with a covering of about 2 feet of muck. The creek is difficult to work on account of the live water in the gravels. Through part of their length the gravels are frozen on the bottom and thawed for several feet above, so that drifts must be timbered throughout. The pay frequently goes down into the bed rock 3 or 4 feet.

The gold is generally bright, fine, and somewhat worn. One nugget weighing nearly 4 ounces has been taken out. When poured out of a sack [a] or pan part of it rolls almost like shot, owing to its rounded form. This characteristic is common to a large part of the gold of the Rampart region, but particularly so of this area, and is due to its crystalline form. The crystal faces are often observable on the pieces. The placers of the creek are probably derived largely from reconcentration of the gold from the gravels of the bench through which the creek has cut its course, and in part from the local bed rock. The creek is probably more than half worked out.

RHODE ISLAND CREEK.

Rhode Island Creek is somewhat larger than Gold Run and heads nearer the top of the ridge. Its general conditions of bed rock, gravel, etc., are similar to those of Gold Run, below the mouth of which Rhode Island Creek flows close against a bluff on its western side, while its eastern side rises more gently.

Considerable work has been done on the creek, but during the summer of 1904 no claims were worked. The output is unknown. Miners on other creeks are of the opinion that the gravels would pay for working if water for hydraulicking could be obtained.

SEATTLE CREEK.

Seattle Creek, although the longer stream, is called a tributary of the Rhode Island. It probably carries less than a sluice head of water during an ordinary season. The bed rock in the lower part is carbonaceous schistose grit. The gravels contain bed-rock fragments, quartzite, vein quartz, and carbonaceous slate, and are rather fine. They are said to be 8 to 30 feet thick and covered with 1 to 3 feet of muck. They are well frozen and have no live water. About $100 was taken out in the course of prospecting during the winter of 1903–4. The gold is said to be bright, fine, and shotty. Prospecting was to be continued during the winter of 1904–5.

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[a] Known among miners as a "poke."

BENCH WEST OF RHODE ISLAND CREEK.

A spur on the west side of Rhode Island Creek, similar to the one on the west side of Eureka Creek, has a well-defined bench cut upon it, extending about one-half mile to Omega Creek Valley. The bench is about 300 feet above the bed of Rhode Island Creek and is covered with subangular gravel, through which gold is said to be found. It is about on a level with Shirley Bar.

OMEGA CREEK.

General description.—Omega Creek, another small stream, heads in a ridge about 2 miles southwest of the head of Minook Creek and about one-half mile west of Seattle Creek, flows almost south for one-half mile or more, and then swings gradually to the west. As soon as it takes a westerly course the shape of its valley becomes similar to that of Eureka Creek, having a steep hill on the south, against which the stream flows, and on the north side a gentle slope to the ridge above, rising more steeply in its upper portion.

Gold was discovered in Omega Creek in 1899, but the first pay was found in 1901. The creek has been worked in only a small way, and the production has been small. The bed rock is a black, fissile, much-broken slate, and a yellowish, somewhat schistose grit. It has a strike of N. 70° E., with a high northerly dip. The gravel is about 7 feet deep, very angular and fine, and is made up of the country rock with a small amount of quartzite. There is little or no muck over the gravel, but there is a sticky clay through it which probably carries off some of the fine gold.

Values and mining.—The pay is known to extend for about 1 mile down the creek from a point due west of the mouth of Seattle Creek. The width of the pay is unknown. One cut 30 feet wide has been taken out, and it is known that the pay extends to both sides, rising on a low bench on the right (northwest). This cut is at the upper end of the pay streak. The gold is distributed through the gravel both top and bottom. It is "shotty" and coarse, and much of it is very rough. Many pieces show crystal faces, and all the larger pieces and many of the smaller pieces contain quartz. In color the gold is more brassy than most of the gold of the region. A great many small crystals of pyrites occur in the concentrates with the gold. So far the claim has been worked only by an open cut, but some of the gravel was thought to be deep enough to be workable by drifting and this method was to be tried during the winter of 1904–5. The water supply is small and a dam has been put in to collect the water so that sluicing can be carried on about half the time during an ordinary season.

CHICAGO CREEK.

Chicago Creek is a small rivulet flowing down the northern slope to Omega Creek about 2½ miles west of the mouth of Seattle Creek. Pay was reported to have been discovered near its mouth during the summer of 1904, and it was the intention to work it during the winter.

THANKSGIVING CREEK.

Thanksgiving Creek is a small tributary of Omega Creek, between 4½ and 5 miles west of Eureka Creek. It occupies a shallow, open depression in the southern slope of the ridge, on the north side of Baker Flats, and can hardly be said to have a valley in its lower part. It is almost dry in the summer and fall. Gold was discovered on it in February, 1903. The combined output of Omega and Thanksgiving creeks has been about $18,200.

The bed rock is exposed only in the diggings, but where seen was a yellowish, somewhat schistose grit. The gravel varies in depth from 6 to 18 feet where the creek is worked, though it is said to be deeper farther downstream. It is composed of subangular pieces of quartzite, schistose grit, vein quartz, slate, and a small amount of monzonitic rock. The overlying muck is 1 to 4 feet in thickness.

The gravel is peculiarly mixed with a sticky yellow clay, which in places seems to be half ice. In some of the deeper holes there is 10 feet of this mixed clay and ice. It can not be worked with wood fires, for when melted it runs down upon the fires and quenches them. In open cuts the sides when melted move together like a mass of yellow tar. In some of the holes the section is said to show 10 to 12 feet of finely mixed yellow clay and ice, of which 5 feet is fully half ice and below this there is 6 feet of subangular gravel. The pay streak varies in width from 25 to 45 feet, and is 1½ to 9 feet thick. Gold is sometimes distributed through the yellow clay and colors always occur through the mixture of clay and ice. At one place where the pay is found through 7 feet of the ice-clay mixture, when the mass is thawed the pay sinks to the lower 4 feet. If the clay is dried it is difficult to part the gold from it, and at one claim, on which open-cut work was progressing, angular pieces of sheet iron like saw teeth were driven into the poles used in the sluice boxes to break up the clay. The iron pieces were left projecting about three-fourths of an inch, and 25 were used to a 6½-foot pole. The device is said to work well.

The gold is generally rough and somewhat iron stained, but some of it is smooth, bright, and "shotty." Some "black sand" is said to be with it in the concentrates. R. H. Wright picked out 8.48 ounces of the smooth, bright gold, and the United States assay office at Seattle gave it a value of $15.64 per ounce. In it there were 1.68 ounces of silver and 0.4 ounce of impurities; 32.03 ounces of the gold as it

came from the sluice boxes contained 6.38 ounces of silver and 2.41 ounces of impurities, and had a value of $15.17 per ounce. Each assay gives about 20 per cent as the silver content of the gold.

Water for sluicing is brought from Eureka and Chicago creeks, but the supply is scanty. The probabilities are that the production of gold upon Thanksgiving Creek will increase considerably, but as in most of the diggings of the Baker Creek group more water is needed.

HUTLINA CREEK.

Hutlina Creek is a large tributary of Baker Creek, several miles southeast of, and having a generally parallel course to Pioneer Creek. As seen from Glenn Creek its valley and that of its principal tributary are shaped similarly to those of Pioneer and Eureka creeks, and prospectors confirm this impression. A stampede to the Hutlina occurred in 1902, and it is reported that colors and occasionally good prospects were found, but live water in the gravels prevented their being worked without machinery. The bed rock is said to be similar to that of Pioneer Creek. At the time the Geological Survey party left Rampart, September 20, 1904, several prospectors were going into the valley with tools and provisions to prospect the benches during the winter.

PATTERSON CREEK.[a]

The following notes, collected from various sources, are considered reliable, though the writer was not able to verify them by personal observation.

Patterson Creek is a tributary of the lower Tanana, some of whose tributaries rise in Rough Top Mountain and others in a broad, flat divide between the Tanana and Left Fork of Baker Creek. Gold was discovered on Patterson Creek at the mouth of Easy Money and Sullivan creeks, which join to form the main valley. The scene of the discovery lies close to the trail from Hot Springs to the mouth of the Tanana. The gravels are from 35 to 70 feet deep, and the bed rock is chiefly slate. The gold is similar in character to that found on Glenn Creek. Although there was no actual mining in this district in 1907, sufficient gold had been found to warrant careful prospecting. This occurrence appears to be similar to the placers of the Glenn Creek region. Its position and character suggest that the Patterson Creek deposit may represent a southwestern extension of the Glenn Creek district.

WATER FOR HYDRAULICKING.

A large part of the gravels of the creeks and benches of the Baker Creek area, while they will not pay for shoveling in, would probably pay for working if water for hydraulicking could be obtained at a

[a] By Alfred H. Brooks.

reasonable cost. But, as has been said, the creeks of the region are small and furnish hardly enough water for ordinary sluicing operations.

Miners say that Hutlina Creek would furnish plenty of water for hydraulicking, but the distance it would have to be carried is variously estimated at 8 to 15 miles. Were water brought from this creek it would have to be piped through a large part of the distance to retain the head. In connection with hydraulic mining in this region the writer can do no better than quote the remarks of L. M. Prindle[a] upon the subject:

Outlook for hydraulic mining.—The installation of a hydraulic plant in any of the placer regions of the Yukon-Tanana country involves the expenditure of an amount of money several times in excess of that required for similar work in the States and should be preceded by much careful preliminary study of all the conditions. The transformation of available water supply into a powerful tool of excavation and transportation and the use of this tool in the most skillful and efficient manner are among the most important problems of mining. Lack of knowledge and skill may be covered by the results where the ground is very rich, but with ground like that under consideration the possession of these qualities or the lack of them may make all the difference between success and failure. Directors and stockholders of companies planning such work should insist upon and be constantly ready to bear the expense of the intelligent study of conditions and careful management of operations.

GENERAL CONCLUSIONS.

The rocks of the Baker Creek area are interbedded schistose grits, slates, and quartzites, with the grits forming the larger part. The grits and slates are often carbonaceous. Igneous rocks were found only along the crest of the divide, and not in large quantity. When compared with the Klondike or the Nome gold-producing regions, the small amount of metamorphism and mineralization and the scarcity of quartz veins and stringers are very noticeable.

The source of the gold is probably local, and the richer placers are generally in the vicinity of carbonaceous phases of the rocks. There is frequently reconcentration from older gravels where the streams cut across gravel-covered benches and hillsides. The gold, though generally close to bed rock, is sometimes distributed through a considerable thickness of gravel and muck. It often occurs in small crystals, and is thus shotty and chunky and easy to save. Large nuggets are rare. It contains a large amount of silver, so that its value per ounce is much lower than that of the gold of the Minook Creek area, running from $14.88 to a little over $16. There are few minerals accompanying the gold, a little pyrite, magnetite, and hematite being the only ones noticed.

[a] Prindle, L. M., and Hess, F. L., The Rampart placer region, in Report on progress of investigations of mineral resources of Alaska: Bull. U. S. Geol. Survey No. 259, 1905, pp. 104–119.

The creeks are all small and some have been half worked out or more, but new deposits have been discovered each year and more will probably be found. Water for working the claims is scarce, and, although some ground which will not pay for shoveling in would probably pay for hydraulicking under favorable conditions, water in adequate quantity and under a sufficient head can not be obtained without considerable expense. One of the greatest needs is a good road from Rampart, and until that is made supplies must continue excessively high.

TROUBLESOME CREEK GROUP.

GENERAL DESCRIPTION.

The Troublesome Creek group is situated between the arms of the Y formed by the divides separating the drainage basins of Minook, Baker, and Troublesome creeks. It is 18 or 20 miles southeast of Rampart. Troublesome Creek, rising among the hills east of Wolverine Mountain, flows northeast to Hess Creek, a tributary of the Yukon. The tributary valleys are often narrow and shut in by hills with steep sides and ridges, closely resembling each other, and making traveling so difficult that the country has come by its name honestly.

So far pay dirt has been found upon two creeks, Quail and Gunnison, though colors are found through the gravels over a wide area.

The rocks include all the varieties present in the Rampart formation, but slates are characteristic of the upper valley and greenstones of the lower. The slates have been intruded by a variety of igneous dikes. The creeks have cut benches upon the hills, but to a less degree than in Minook Valley.

CREEKS PROSPECTED.

QUAIL CREEK.

Quail Creek heads opposite Hoosier Creek and flows eastward into Troublesome Creek, having a length of between 5 and 6 miles. A large branch of this creek, known as South Fork, joins Quail Creek about a mile above Troublesome Creek. Between the two branches is a gravel-covered bench 400 feet high, upon which colors have been found, and which is being prospected. Parts of this bench occur at various places farther up Quail Creek. On the north side of Quail Creek is another bench about 50 feet above the creek, and this, too, is being prospected. In one hole bed rock was reached at 29 feet. There were 19 feet of muck and 10 feet of well-washed gravel. Colors were found all through the gravel, but no pay.

A number of igneous dikes which cross the lower part of Quail Creek show considerable mineralization by metallic sulphides. An assay of a porphyry gave no gold, but 0.52 ounce of silver [a] per ton.

The creek was located in 1898, and it is said that it was desired to call the stream " Ptarmigan " Creek, but as no one in the party could spell ptarmigan it was named " Quail," the spelling of which was easier. Some gold is said to have been taken out in that year, and a little was taken out during the summer of 1904. The total is thought to be about $3,300.

There seems to be a considerable accumulation of gravels at some places, while at others the bed rock rises to the surface. The gravels are of the country rock, with many bowlders of porphyritic granitic rocks.

A number of miners were fixing up old cabins and building new ones, and getting ready to prospect the creek during the winter.

GUNNISON CREEK.

Gunnison Creek is located a few miles farther down Troublesome Creek on the same side as Quail Creek. Miners are said to have worked upon it during the summer of 1904, and to have taken out some gold, but no further particulars were learned. The creek was not visited by the Geological Survey party.

GENERAL SUMMARY.

The alluvial deposits formed from the rocks of the valleys in which the deposits occur are found both in stream channels and on benches, and are probably all of stream origin. They are of Recent and Pleistocene age, and their thickness is generally near 5 feet, but varies from 5 to 100 feet.

The gold is generally found in the lower 2 or 3 feet of the gravel and upper 1 or 2 feet of the bed rock, but on Shirley Bar and Omega Creek it is in places distributed through the whole depth of the gravel, 5 to 7 feet, and on Omega Creek the gold is found not only in the gravel but through several feet of intimately mixed ice and clay.

The placers are of two general types as regards their origin, placers of ordinary concentration from the disintegration and wearing down of the bed rock, and placers formed through reconcentration of the gold in older gold-bearing gravels by the cutting of streams. The bench gravels of the region and the placers of Ruby and Slate creeks belong to the first class. To the second class belong the placers of the creeks cutting the high bench of Minook Creek and the placers of Doric, Glenn, and Seattle creeks and Gold Run. The other

[a] Burlingame, E. E., & Co., Denver, Colo.

placers of the region probably belong to the first class, although there may be some reconcentrated gold in Thanksgiving and Quail creeks.

The gold of the reconcentrated placers is generally smoother and brighter than that from the others, contains less quartz and iron, owing to abrasion and oxidation, and is thus higher in value per ounce, though the higher value of the gold of the Minook group is principally due to its containing less silver than the gold of other creeks. There is much crystallization in the gold, particularly of the Baker Creek group, where the gold contains a large percentage of silver. It is notable that along Minook Creek, where the gold contains so little silver, native silver nuggets are found in the placers, while in the Baker Creek group, where the placer gold contains about 20 per cent of combined silver, there are no silver nuggets. The only other minerals known in the concentrates with the gold are hematite, a small amount of magnetite on Thanksgiving Creek, pyrite, garnets on Ruby Creek, barite on a few other creeks, and copper on Hunter, Little Minook, and Slate creeks.

In all cases the origin of the gold has probably been in the immediate neighborhood of the placers, though it may be the result of the concentration of many hundreds of feet of bed rock. There seems to be no indication that the gold has been derived from any great "mother lode," and it has probably come from comparatively small veins distributed through the country rock.

All of the creeks at present known to be gold bearing to a paying extent, except Slate and Ruby creeks, take their rise in the Minook-Baker-Troublesome divide. Along this divide are dikes of monzonitic, dioritic, and acid igneous rocks, and it may be that these were associated with causes that introduced gold-bearing solutions into the rocks. The large mass of diabasic rocks in the Minook group may have been related in some way with the mineralization of that area.

As to the origin of the silver and copper nuggets with the gold in the creeks of the Minook group, little can be said. On all the creeks in which they are found, except Slate Creek, both limestones and diabases occur. On Slate Creek diabase was not seen, although there is much of it on Ruby Creek. It is likely that the silver and copper nuggets come from the oxidation of contact minerals resulting from the diabasic intrusions.

The average depth of gravel worked is probably between 10 and 20 feet. The gravels are mostly frozen, but much trouble in working them is sometimes had on account of live water. Hydraulicking has been introduced and apparently works well in the frozen gravels. This form of mining will probably become of considerable importance

in the Minook Creek group wherever plenty of water and head are obtainable. In the Baker Creek group the expense of obtaining water for hydraulicking seems to be very much greater, though data are lacking. There is much gravel in this group, which can probably be worked at a profit only by this method. In the Troublesome country there is plenty of water, with sufficient fall for hydraulicking in that valley.

The following tables give the most important statistical data of the Rampart region and include the total gold production, so far as ascertainable, up to the fall of 1904:

Distances, men employed, and freight rates of Rampart region, 1904.

Name of diggings.	Distance from Rampart.	Number of men employed.	Freight rates.	
			Winter.	Summer.
	Miles.		*Cents per pound.*	*Cents per pound.*
Hunter Creek	3	15	2	4
Little Minook Creek	4½	30	2	4
Little Minook Junior Creek	5	10	2	4
Hoosier Creek	6	7	2	4
Florida Creek	8	....	....	....
Ruby Creek	9	10	3	5
Slate Creek	11	5	4	8
Eureka Creek	28		6	15
Bench bars	30	40	6	15
Doric Creek	30		6	15
Glenn Creek	30	24	6	15
Gold Run	31	10	6	15
Seattle Creek	31	....	6	15
Omega Creek	32	3	6	15
Thanksgiving Creek	34	10	6	15
Quail Creek	20	5	6	15-20
Total	....	169	....	....

Gold production of Rampart region.

Name of diggings.	Winter of 1903-4.	Summer of 1904.	Total, 1904.	Previous to 1904.	Total to fall, 1904.
Minook Creek	....	....	....	$10,000	$10,000
Hunter Creek	$3,000	$3,000	$6,000	18,000	24,000
Little Minook Creek	40,000	2,900	42,900	443,200	486,100
Little Minook Junior Creek	17,000		17,000	133,000	150,000
Hoosier Creek	500	....	500	1,500	2,000
Florida Creek	....	....	....	2,000	2,000
Ruby Creek	3,000	2,000	5,000	8,500	13,500
Slate Creek	12,000	3,000	15,000	....	15,000
Eureka Creek					
Bench bars	45,500	16,500	62,000	23,300	85,300
Doric Creek					
Glenn Creek	11,000	39,500	50,500	227,000	277,500
Gold Run	16,000	....	16,000	9,000	25,000
Seattle Creek	100	....	100	....	100
Omega Creek	12,100	5,300	17,400	800	18,200
Thanksgiving Creek					
Quail Creek	....	500	500	2,800	3,300
Total	160,200	72,700	232,900	879,100	1,112,000

Total production previous to 1905	1,112,000
Total production for 1905	200,000
Total production for 1906	270,000
Total production of Rampart region previous to 1907	1,582,000

INDEX.

RECENT SURVEY PUBLICATIONS ON ALASKA.

[Arranged geographically. A complete list can be had on application.]

All of these publications can be obtained or consulted in the following ways:

1. A limited number are delivered to the Director of the Survey, from whom they can be obtained, free of charge (except certain maps), on application.

2. A certain number are delivered to Senators and Representatives in Congress for distribution.

3. Other copies are deposited with the Superintendent of Documents, Washington, D. C., from whom they can be had at prices slightly above cost.

4. Copies of all Government publications are furnished to the principal public libraries throughout the United States, where they can be consulted by those interested.

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Topographic maps.

The following maps are for sale at *5 cents a copy*, or $3 per hundred:
Casadepaga Quadrangle, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.
Grand Central Special, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.
Nome Special, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.
Solomon Quadrangle, Seward Peninsula; scale, 1:62500; by T. G. Gerdine.

The following maps are for sale at *25 cents a copy*, or $15 per hundred:
Seward Peninsula, northeastern portion of, topographic reconnaissance of; scale, 1:250000; by T. G. Gerdine.
Seward Peninsula, northwestern portion of, topographic reconnaissance of; scale, 1:250000; by T. G. Gerdine.
Seward Peninsula, southern portion of, topographic reconnaissance of; scale, 1:250000; by T. G. Gerdine.

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Water-supply investigations in Alaska, 1906 and 1907, by F. F. Henshaw and C. C. Covert. Water-Supply Paper No. 218, 1908, 156 pp.
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Koyukuk River to mouth of Colville River, including John River; scale, 1:1200000; by W. J. Peters. Contained in Professional Paper No. 20. (Out of stock.) Not published separately.

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